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(54) Title: ELASTOMERIC TAPES WITH MICROTEXTURED SKIN LAYERS
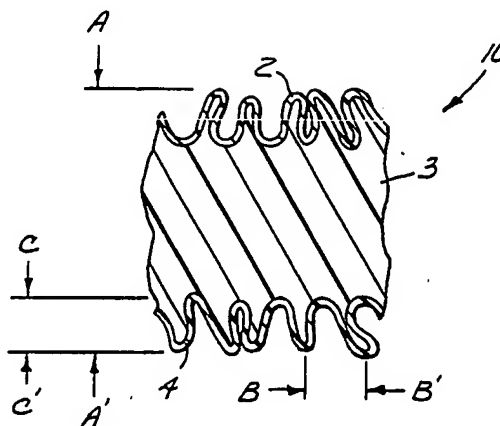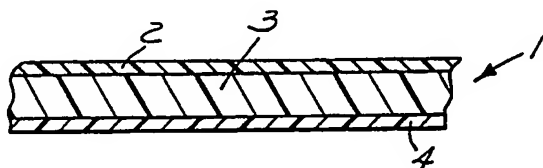
(57) Abstract

Microtextured elastomeric laminate tape (1) comprising a laminate with at least one elastomeric layer (3) and at least one thin skin layer (2, 4), and an adhesive layer, preferably prepared by coextrusion of the layers followed by stretching the laminate past the elastic limit of the skin layers and then allowing the laminate tape to recover.

ELASTOMERIC TAPES WITH MICROTEXTURED SKIN LAYERS

FIELD OF THE INVENTION

5   The invention concerns elastomeric tape and more specifically concerns tape laminates. These tape laminates are particularly useful in garment applications.

BACKGROUND

Elastomeric tapes are known and used for a
10   variety of purposes. The most common use of elastomeric tapes is as a stretchable backing for a bandage. This is discussed in, e.g., U.S. Pat. No. 3,618,754 (Hoey), which describes a composite structure using a woven layer having elastomeric warp yarns interspersed with flexible warp
15   yarns, the cross or filler yarns are exemplified as cotton. The elastomeric yarns are preferably an elastomeric Spandex^{TM} core with a rayon spun outer covering. This tape is complex and difficult to manufacture. Other constructions for bandage tapes are
20   likewise complex with many designed to provide controlled modulus behavior. Namely, a tape is preferred that has only a limited degree of extensibility and then a high modulus value.

Elastomeric tapes have also been proposed for
25   use as electrical insulating tapes based on the electrical properties of rubber as well as their ability to grip a surface, i.e. with their recovery forces when applied under stress. These types of elastic tapes are described, for example, in U.S. Pat. Nos. 3,379,562, 2,559,909 and
30   3,253,073, which are all described as insulating tapes.

U.S. Pat. No. 2,559,990 describes a basic elastic tape of an elastic film forming polymer with a rubber-resin adhesive coating. The elastomer is described as a plasticized vinyl chloride with a blend of
35   plasticizers in permanent equilibrium with a rubber resin adhesive. When this tape is wound into a roll form a

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liner is used. This liner must be removed when the tape
is us d to allow it to adhere to itself.

Elimination of this removable liner is proposed
in U.S. Pat. No. 3,379,562, which places a barrier layer
on the tape backside which shatters when stretched. This

5   allegedly exposes the rubber and allows tape to adhere to
itself when the tape is stretched. However, fragments of
the barrier layer can still interfere with adhesion of the
tape to itself.

U.S. Pat. No. 3,253,073 describes a tape

10 allegedly designed for high temperature performance. The
tape substrate is a laminate of two insulating rubber
layers sandwiching a fiber layer. The fibers are brittle
and when the tape is stretched sufficiently the fibers
break, thereby making the tape elastic in the stretch

15 direction. These fibers are used to improve high
temperature performance.

A purely elastomeric tape was also disclosed in
U.S. Pat. No. 4,024,312 although no specific uses are
proposed. The tape comprises a ABA block copolymer based

20 rubber substrate with a rubber resin adhesive on one side
and a release coat on the other. The high extensibility
allegedly allows the tape to be easily removed when peeled
at substantially 0°. This is stated as a desirable
quality for ouchless bandages.

25 Elastic tapes or tapes with elasticized regions
have also been proposed as closures for diapers, and the
like, in U.S. Pat. Nos. 4,389,212, 3,800,796, 4,643,729,
4,778,701 and 4,834,820. In U.S. Pat. No. 4,834,820, an
elastic tab is provided with either a removable central

30 section or a inelastic cover layer adhered at only the
ends of the elastic. When the removable section is
removed, the elastic loses its support and is free to
stretch. With an unattached central portion of a cover
layer, the central portion has a line of weakness which

35 when broken frees the central elastic region. U.S. Pat.
No. 4,778,701 also provides an elasticized central region

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in a composite tape. An elastic strip is adhered to two
non lastomeric anchor strip tapes used to attach either
side of the diaper. Complex constructions having features
of the above two patents are described in U.S. Pat. Nos.
4,643,729 and 4,389,212. U.S. Pat. No. 3,800,796
describes tapes with elasticized central portions and
rigid ends with adhesive layers. All of these tapes are
complex multicomponent composites aimed at providing only
limited elastic central tape portions.

SUMMARY OF THE INVENTION

The present invention relates to non-tacky,
microtextured, multi-layer elastomeric laminated tapes.
The laminate tape backings of the present invention are
comprised both of an elastomeric polymeric core layer(s),
which provides elastomeric properties to the laminate and
one or more polymeric skin layers which are capable of
becoming microtextured. This microtexturing gives the
tape natural low adhesion backsize properties, increases
ink receptivity, acts as an adhesive primer, and lowers
the laminate coefficient of friction and modulus. In
preferred embodiments of the present invention the skin
layer further can function to permit controlled release or
recovery of the stretched elastomer, modify the modulus of
elasticity of the elastomeric tape and/or stabilize the
shape of the elastomeric tape (i.e., by controlling
further necking). The laminate tape backings can be
prepared by coextrusion of the selected polymers or by
application of one or more elastomer layers onto one or
more already formed skin layer(s) or vice versa.
Coextrusion is preferred. Pressure-sensitive adhesive
(hereinafter adhesive) can be applied by any conventional
mechanism including coextrusion. The novel microtextured
laminate tape and/or tape backing is obtained by
stretching the laminate past the elastic limit of the skin
layers. The laminate then recovers, which can be
instantaneous, over an extended time period, which is

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skin in layer controllable, or by the application of heat, which is also skin layer controllable.

Stretching of the laminate tape or backing can be uniaxial, sequentially biaxial, or simultaneously biaxial. It has been found that the method and degree of stretch allows significant control over the microtextured surface that results, allowing formation of novel surfaces and adhesion properties. The invention thus further provides various novel surfaces and also a method for the controlled production of these surfaces.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a cross-sectional segment of an extruded laminate tape backing 1 before microstructuring.

Fig. 2 is a cross-sectional segment of the Fig. 1 laminate tape backing with microstructuring caused by uniaxial stretching.

Fig. 3 is a scanning electron micrograph (200x) of a microstructured laminate tape backing that has been uniaxially stretched.

Fig. 4 is a schematic representation of a process and apparatus used to coextrude laminate tapes and/or backings.

Fig. 5 is a diagram showing the stress-strain characteristics of a laminate backing and its component layers.

Fig. 6 shows an electron micrograph (1000x) of a sample of the present invention with a polyethylene skin which was simultaneously biaxially stretched.

Fig. 7 is a photograph of a unstretched laminate tape backing that has been marked with ink.

Fig. 8 is a photograph of the stretched and recovered laminate of Fig. 7 marked with the same ink.

Fig. 9 (T-N) are stress/strain curves for a series of laminate films.

Fig. 10 is a scanning electron micrograph (100x) of the surface of a laminate tape backing which has b en sequentially biaxially stretched.

Fig. 11 is a scanning electron micrograph (100x) of a simultaneously biaxially stretched invention laminate which has a polypropylene(PP) skin.

Fig. 12 is a diagram showing the relationship between the shrink mechanism and the core/skin ratio and stretch ratio for a second uniaxially stretched film.

Fig. 13 is a diagram showing the relationship between the core/skin ratio, the percent of total recovery and activation temperature.

Fig. 14 is a diagram of a tape after stretch and activation where the adhesive is a thin coating.

Fig. 15 is a diagram as per Fig. 14 with a thicker adhesive coating.

Fig. 16 is a scanning electron micrograph (200x) of a tape having a thin adhesive layer which forms an undulating surface.

Fig. 17 is a scanning electron micrograph (200x) of a tape having a thick adhesive forming a relatively flat surface.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

The present invention relates broadly to novel tape using a non-tacky, multi-layer elastomeric laminate backing comprising at least one elastomeric core layer and at least one relatively nonelastomeric skin layer. The skin layer is stretched beyond its elastic limit and is relaxed with the core so as to form a microstructured surface. Microstructure means that the surface contains peak and valley irregularities or folds which are large enough to be perceived by the unaided human eye as causing increased opacity over the opacity of the laminate before microstructuring, and which irregularities are small enough to be perceived as smooth or soft to human skin.

Magnification of the irregularities is required to see the
details of the microstructured texture.

The elastomer can broadly include any material
which is capable of being formed into a thin film layer
and exhibits elastomeric properties at ambient conditions.
Elastomeric means that the material will substantially
resume its original shape after being stretched. Further,
preferably, the elastomer will sustain only small
permanent set following deformation and relaxation which
set is preferably less than 20 percent and preferably less
than 10 percent of the original length at moderate
elongation, e.g., about 400-500%. Generally, any
elastomer is acceptable which is capable of being
stretched to a degree that causes relatively consistent
permanent deformation in a relatively inelastic skin
layer. This can be as low as 50% elongation. Preferably,
the elastomer is capable of undergoing up to 300 to 1200%
elongation at room temperature, and most preferably up to
600 to 800% elongation at room temperature. The elastomer
can be both pure elastomers and blends with an elastomeric
phase or content that will still exhibit substantial
elastomeric properties at room temperature.

Heat-shrinkable elastics have received
considerable attention due to the ability to attach the
elastic to a product, using the unstable stretched
elastomer at ambient conditions, and then later applying
heat to shirr the product, such as a diaper. Although
these elastomers are contemplated for use in the present
invention tape, other non-heat shrinkable elastomers can
be used while retaining the advantages of heat
shrinkability and with the added dimension of the
possibility of substantially controlling the heat shrink
process. Non-heat shrinkable means that the elastomer,
when stretched, will substantially recover sustaining only
a small permanent set as discussed above. Therefore, the
elastomeric layer can be formed from non-heat-shrinkable
polymers such as block copolymers which are elastomeric

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such as those known to those skilled in the art as A-B or
A-B-A block copolymers. Such copolymers are described for
example in U.S. Patent Nos. 3,265,765; 3,562,356;
3,700,633; 4,116,917 and 4,156,673. Styrene/isoprene,
butadiene or ethylene-butylene/styrene (SIS, SBS or SEBS)
block copolymers are particularly useful. Other useful
elastomeric compositions can include elastomeric
polyurethanes, ethylene copolymers such as ethylene vinyl
acetates, ethylene/propylene monomer copolymer elastomers
or ethylene/propylene/diene terpolymer elastomers. Blends
of these elastomers with each other or with modifying
non-elastomers are also contemplated. For example, up to
50 weight percent, but preferably less than 30 weight
percent, of polymers can be added as stiffening aids such
as polyvinylstyrenes, polystyrenes such as
poly(alpha-methyl)styrene, polyesters, epoxies,
polyolefins, e.g., polyethylene or certain ethylene/vinyl
acetates, preferably those of higher molecular weight, or
coumarone-indene resin. The ability to use these types of
elastomers and blends provides the invention laminate with
significant flexibility.

Viscosity reducing polymers and plasticizers can
also be blended with the elastomers such as low molecular
weight polyethylene and polypropylene polymers and
copolymers, or tackifying resins such as Wingtack™,
aliphatic hydrocarbon tackifiers available from Goodyear
Chemical Company. Tackifiers can also be used to increase
the adhesiveness of an elastomeric layer to a skin layer.
Examples of tackifiers include aliphatic or aromatic
liquid tackifiers, polyterpene resin tackifiers, and
hydrogenated tackifying resins. Aliphatic hydrocarbon
resins are preferred.

Additives such as dyes, pigments, antioxidants,
antistatic agents, bonding aids, antiblocking agents, slip
agents, heat stabilizers, photostabilizers, foaming
agents, glass bubbles, starch and metal salts for
degradability or microfibers can also be used in the

elastomeric core layer(s). Suitable antistatic aids
include ethoxylated amines or quaternary amines such as
those described, for example, in U.S. Pat. No. 4,386,125
(Shiraki), who also describes suitable antiblocking
agents, slip agents and lubricants. Softening agents,
tackifiers or lubricants are described, for example, in
U.S. Pat. No. 4,813,947 (Korpman) and include
coumarone-indene resins, terpene resins, hydrocarbon
resins and the like. These agents can also function as
viscosity reducing aids. Conventional heat stabilizers
include organic phosphates, trihydroxy butyrophenone or
zinc salts of alkyl dithiocarbonate. Suitable
antioxidants include hindered phenolic compounds and
amines possibly with thiodipropionic acid or aromatic
phosphates or tertiary butyl cresol, see also U.S. Pat.
No. 4,476,180 (Wnuk) for suitable additives and
percentages.

Short fibers or microfibers can be used to
reinforce the elastomeric layer for certain applications.
These fibers are well known and include polymeric fibers,
mineral wool, glass fibers, carbon fibers, silicate fibers
and the like. Further, certain particles can be used,
including carbon and pigments.

Glass bubbles or foaming agents are used to
lower the density of the elastomeric layer and can be used
to reduce cost by decreasing elastomer content required.
These agents can also be used to increase the bulk of the
elastomer. Suitable glass bubbles are described in U.S.
Patent Nos. 4,767,726 and 3,365,315. Foaming agents used
to generate bubbles in the elastomer include
azodicarbonamides. Fillers can also be used to some
extent to reduce costs. Fillers, which can also function
as antiblocking agents, include titanium dioxide and
calcium carbonate.

The skin layer can be formed of any semi-
crystalline or amorphous polymer that is less elastic than
the elastomeric core layer(s) and will undergo permanent

deformation at th str tch percentage that the elastomeric
laminate will undergo. Therefore, slightly lastic
compounds, such as some olefinic elastomers, e.g.
ethylene-propylene elastomers or ethylene-propylene-diene
terpolymer elastomers or ethylenic copolymers, e.g.,
ethylene vinyl acetate, can be used as skin layers, either
alone or in blends. However, the skin layer is generally
a polyolefin such as polyethylene, polypropylene,
polybutylene or a polyethylene-polypropylene copolymer,
but may also be wholly or partly polyamide such as nylon,
polyester such as polyethylene terephthalate,
polyvinylidene fluoride, polyacrylate such as poly(methyl
methacrylate) (only in blends) and the like, and blends
thereof. The skin layer material can be influenced by the
type of elastomer selected. If the elastomeric layer is
in direct contact with the skin layer the skin layer
should have sufficient adhesion to the elastomeric core
layer such that it will not readily delaminate.
Acceptable skin-to-core contact has been found to follow
three modes: first, full contact between core and
microtextured skin; second, cohesive failure of the core
under the microstructure folds; and third, adhesive
failure of the skin to the core under the microstructure
folds with intermittent skin/core contact at the fold
valleys. However, where a high modulus elastomeric layer
is used with a softer polymer skin layer attachment may be
adequate yet a microtextured surface may not form.

     The skin layer is used in conjunction with an
elastomeric layer and can either be an outer layer or an
inner layer (e.g., sandwiched between two elastomeric
layers). Used as either an outer or inner layer the skin
layer will modify the elastic properties of the
elastomeric laminate.

     Additives useful in the skin layer include, but
are not limited to, mineral oil extenders, antistatic
agents, pigments, dyes, antiblocking agents, provided in
amounts less than about 15%, starch and metal salts for

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degradability and stabilizers such as those described for
the elastomeric core layer.

Other layers may be added between the
elastomeric core layer and the skin layers, such as tie
layers to improve the bonding of the layers. Tie layers
can be formed of, or compounded with, typical compounds
for this use including maleic anhydride modified
elastomers, ethyl vinyl acetates and olefins, polyacrylic
imides, butyl acrylates, peroxides such as peroxypolymers,
e.g., peroxyolefins, silanes, e.g., epoxysilanes, reactive
polystyrenes, chlorinated polyethylene, acrylic acid
modified polyolefins and ethyl vinyl acetates with acetate
and anhydride functional groups and the like, which can
also be used in blends or as compatibilizers in one or
more of the skin or core layers. Tie layers are
particularly useful when the bonding force between the
skin layers and elastomeric core layer(s) is low. This is
often the case with polyethylene skin as its low surface
tension resists adhesion. However, any added layers must
not significantly affect the microstructuring of the skin
layers. Tie layers may, however, be omitted even when
bonding between skin and core is low. For example, for
tamper-indicating tapes, low adhesion delamination can be
used advantageously.

One unique feature of the invention is the
ability to control the shrink recovery mechanism of the
tape depending on the conditions of the laminate film
formation, the nature of the elastomeric layer, the nature
of the skin layer, the manner in which the laminate film
backing is stretched and the relative thicknesses of the
elastomeric layer(s) and skin layer(s). By controlling
these variables in accordance with the teaching of this
invention, the laminate tape or backing can be designed to
instantaneously recover, recover over time or recover upon
heat activation.

A laminate capable of instantaneous shrink is
one in which the stretched elastomeric laminate will

recover more than 15% in 1 sec. A laminate capable of
time shrink is one where the 15% recovery point takes
place more than 1 sec., preferably more than 5 sec., most
preferably more than 20 sec. after stretch, and a laminate
capable of heat shrink is where less than 15% shrink
recovery occurs to the laminate in the first 20 seconds
after stretch. Percent recovery is the percent that the
amount of shrinkage is of the stretched length minus the
original length. For heat shrink, there will be an
activation temperature which will initiate significant
heat activated recovery. The activation temperature used
for heat shrink will generally be the temperature that
will yield 50% of the total possible recovery (T_{a-50}) and
preferably this temperature is defined as the temperature
which will yield 90% (T_{a-90}) of the total possible
recovery. Total possible recovery includes the amount of
preactivation shrinkage.

Generally, where the skin layer of the laminate
tape backing is relatively thin, the laminate will tend to
contract or recover immediately. When the skin thickness
is increased sufficiently the laminate can become heat
shrinkable. This phenomenon can occur even when the
elastomeric layer is formed from a non-heat shrinkable
material. Further, by careful selection of the
thicknesses of the elastomeric layer and the skin
layer(s), the temperature at which the laminate recovers
by a set amount can be controlled within a set range. .
This is termed skin controlled recovery where generally by
altering the thickness or composition of the skin, one can
raise the activation temperature of an elastomeric core by
a significant degree, generally more than at least 10°F
(5.6°C) and preferably by 15°F (8.3°C) and more. Although
any skin thickness which is effective can be employed, too
thick a skin will cause the laminate to remain permanently
set when stretched. Generally, where a single skin is
less than 30% of the laminate this will not occur. For
most heat or time shrink materials the stretched laminate

must be cooled so that th energy released during
stretching does not cause immediate heat activated
recovery. Fine tuning of the shrink recovery mechanism
can be accomplished by the amount of stretch. This
overall control over the shrink recovery mechanism can be
an extremely important advantage, for example, when the
unactivated tape is used in a manufacturing process. This
control permits adjustment of the recovery mechanism of
the elastomeric laminate tape to fit the requirements of a
manufacturing process rather than the need to adjust a
manufacturing process to fit the shrink recovery mechanism
of the elastomer itself.

        One is also able to use skin controlled recovery
to control the slow or time shrink recovery mechanism, as
with the heat shrink mechanism. This shrink recovery
mechanism occurs as an intermediate between instant and
heat shrink recovery. Skin layer and stretch ratio
control of recovery is possible as in the heat shrink
mechanism, with the added ability to change the shrink
mechanism in either direction, i.e., to a heat or an
instant shrink elastomeric laminate tape.

        A time shrink recovery laminate tape will also
exhibit some heat shrink characteristics and vice versa.
For example, a time shrink laminate tape can be
prematurely recovered by exposure to heat, e.g., at a time
prior to 20 seconds after stretch.

        Recovery can also be initiated for most time
shrink and some low activation temperature heat shrink
recovery laminates by mechanical deformation or
activation. In this case, the laminate tape is scored,
folded, wrinkled, or the like to cause localized stress
fractures that cause localized premature folding of the
skin, accelerating formation of the recovered
microtextured laminate. Mechanical activation can be
performed by any suitable method such as by using a
textured roll, a scoring wheel, mechanical deformation or
the like.

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It was also noted that for most elastomeric laminates over a core-to-skin ratio of about 3 to somewhat above 7, the laminate retained a relatively constant width after it had been restretched. Specifically, if the width of the stretched and recovered film is measured, and if the film is restretched and measured or allowed to recover again and measured, the width remains within at least 20% of its first measured stretch width, preferably within at least 10%. This non-necking characteristic helps prevent the laminate tape from biting into the skin of a wearer when it is used to elasticize a garment or become dimensionally unstable when used as an electrical, wrapping or removable tape, which may cause pop off, tape slippage or the like. Generally, the skin layer will hinder the elastic force of the core layer with a counteracting resisting force. The skin will not stretch with the elastomer after the laminate has been activated, the skin will simply unfold into a rigid sheet. This reinforces the core, resisting or hindering the contraction of the elastomeric core including its necking tendency.

Fig. 12 shows a shrink mechanism diagram for polypropylene/styrene-isoprene-styrene (SIS)/polypropylene(PP) laminates prepared in accordance with Example 29. This diagram demonstrates the ability to control the shrink recovery mechanism by the core/skin ratio and the stretch ratio.

Although Fig. 12 is illustrative of a particular set of starting materials and thicknesses, it does represent the general relationship between the layer ratios and stretch ratio to the shrink mechanism of the laminate. Other variables will affect the above relationship such as overall laminate thickness, the presence of tie layers and the thickness and type of adhesive layer. However, the general relationship between the core/skin ratio and the stretch ratio to the relaxation method will still be present.

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Additives to the core layer discussed above can significantly aff ct the shrink recovery mechanism. For example, stiffening aids such as polystyrene can shift an otherwise heat shrinkable laminate into a time or instant

5   shrink laminate. However, the addition of polypropylene or linear low density polyethylene (less than 15%) to a styrene/isoprene/styrene block copolymer core resulted in exactly the opposite effect, namely transforming time or instant shrink laminates to heat shrink or no shrink laminates. However, the possibility of polyolefin use in

10 the elastomeric core layer is significant from a processing standpoint in permitting limited recycling of off batches and it can lower extruder torque.

A further unique feature of the present invention lies in the ability to significantly reduce the

15 coefficient of friction (C.O.F.) of the elastomeric laminate. The microtexturing is the major factor contributing to this C.O.F. reduction which, as discussed above, is controllable not only by the manner in which the laminate is stretched but also by the degree of stretch,

20 the overall laminate thickness, the laminate layer composition and the core to skin ratio. The dependence of C.O.F. on core/skin ratio is shown in Table II, as the ratio increases the C.O.F. decreases. Thus, fine texture yields lower C.O.F. values. Preferably, the C.O.F. will

25 be reduced by a factor of 0.5 and most preferably by at least a factor of 0.1 of the microtextured laminate to itself in the direction of stretch, when a microstructured surface is formed in accordance with the invention, as compared to the as cast laminate. This ability to reduce

30 C.O.F. is extremely advantageous as it contributes to a softer texture and feel for the laminate, which is desirable for use in the medical and apparel fields.

Writability of the tape is also increased by non-adhesive coated microstructured surfaces that result

35 when the stretched tape recovers. Either organic solvent or water-based inks will tend to flow into the

microstructured surface channels and dry there. Fig. 7
shows the surface of an unstretched, untextured laminate
where the ink clearly beads up. Fig. 8 demonstrates the
improvement in writability for the laminate of Fig. 7,
after stretching and recovery to create a microtextured
surface (see example 26). The more viscous the ink, the
less it will tend to wick in the microchannels of the
surface and hence bleed. Similarly, the more the surface
attraction between the skin layer and the ink, the better
will be the writing characteristics of the microstructured
surface. The writing surface characteristics of the film
can also be altered with conventional additive or surface
treatment techniques to the extent that they do not
interfere with microtexturing.

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The laminate tape backings of the present
invention may be formed by any convenient layer forming
process such as pressing layers together, coextruding the
layers or stepwise extrusion of layers, but coextrusion is
the presently preferred process. Coextrusion, per se, is
known and is described, for example, in U.S. Patent Nos.
3,557,265 to Chisholm et al. and 3,479,425 to Leferre et
al. Tubular coextrusion or double bubble extrusion is
also possible. The layers are typically coextruded
through a specialized die and/or feedblock that will bring
the diverse materials into contact while forming the
laminate.

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Fig. 1 shows a three-layer laminate tape backing
construction in cross section, where the 3 is the
elastomeric layer and 2 and 4 are the skin layers, which
may be the same polymer or different polymers. This layer
arrangement is preferably formed by a coextrusion process.

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One particularly advantageous coextrusion
process is possible with special multilayer, e.g. a
three-layer, combining adapters made by Cloeren Co.,
Orange, Texas. These adapters are described in U.S.
Patent No. 4,152,387 (Cloeren). Streams of thermoplastic
materials flowing out of extruders at different

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viscosities are separately introduced into the adapter,
containing back pressure cavities and flow restriction
channels, and the several layers exiting the flow
restriction channels converge into a melt laminate. The

5   combining adapter is used in conjunction with extruders
supplying the thermoplastic materials to be laminated.
Such a scheme for producing the present invention is shown
schematically in Figure 4, for a three layer adapter. AA,
BB, and CC are extruders. AA', BB' and CC' are streams of

10   thermoplastic materials flowing into the feedblock or
manifold die. D is the 3 or more (e.g., 5-layer) layer
feedblock. E is the die, F is a heated casting roll, and
G and H are rolls to facilitate take-off and roll-up of
the laminate.

15   The die and feedblock used are typically heated
to facilitate polymer flow and layer adhesion. The
temperature of the die depends upon the polymers employed
and the subsequent treatment steps, if any. Generally,
the temperature of the die is not critical but
temperatures are generally in the range of 350 to 550°F

20   (176.7 to 287.8°C) with the polymers exemplified.
Whether the laminate backing is prepared by
coating, lamination, sequential extrusion, coextrusion or
a combination thereof, the laminate formed and its layers
will preferably have substantially uniform thicknesses

25   across the laminate backing. Preferably, the layers are
coextensive across the width and length of the laminate.
With such a construction the microtexturing is
substantially uniform over the elastomeric laminate
surface. Laminates prepared in this manner have generally

30   uniform elastomeric properties with a minimum of edge
effects such as curl, modulus change, fraying and the
like. Further, when wound as in a roll of tape, this will
minimize formation of hard bands, winding problems, roll
telescoping or the like.

35   The laminate backing of the invention has an
unlimited range of potential widths, the width limited

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solely by the fabricating machinery width limitations.
This allows fabrication of microtextured elastomeric tapes
for a wide variety of potential uses.

5   After formation, the laminate tape backing can
be stretched past the elastic limit of the skin, which
deforms. The laminate tape backing then is recovered
instantaneously, with time or by the application of heat,
as discussed above. For heat recovery, the temperature of
activation is determined by the materials used to form the
10   laminate in the first instance. For any particular
laminate, the activation temperature, either T_{a-50} or
T_{a-90}, can be adjusted by varying the skin/core ratio of
the laminate, adjusting the percent stretch or the overall
laminate thickness. The activation temperature used for a
heat shrink laminate is generally at least 80°F (26.7°C),
15   preferably at least 90°F (32.2°C) and most preferably over
100°F (37.8°C). When heat-activated, the stretched
laminates are quenched on a cooling roller, which prevents
the heat generated from the elongation from activating
laminate recovery. The chill roll is below the activation
20   temperature.

          Figure 2 is a schematic diagram of the common
dimensions which are variable for uniaxially stretched and
recovered laminate tape backings. The general texture is
a series of regular repeating folds. These variables are
25   the total height A-A', the peak to peak distance B-B' and
the peak to valley distance C-C'. These variables were
measured for a series of
polyolefin/styrene-isoprene-styrene/polyolefin laminates.
General ranges for A-A', B-B' and C-C' were noted. For
30   total height (A-A'), the range measured was from 0.79 to
32 mils (0.02 to 0.81 mm). For peak-to-peak distance
(B-B'), or the fold period, the measured range was from
0.79 to 11.8 mils (0.02 to 0.30 mm). For peak-to-valley
distance (C-C'), the measured range was from 0.04 to 19.7
35   mils (0.001 to 0.5 mm). These ranges are only exemplary
of the surface characteristics obtainable by the practice

of th present invention. Laminate tape backings of other
compositions will demonstrate different microstructures
and microstructure dimensions. It is also possible to
obtain dimensions outside the above ranges by suitable
selection of core/skin ratios, thicknesses, stretch ratios
5   and layer compositions.

A further unique feature of the invention
laminate tape backing is depicted in Fig. 2. That is,
when the material is stretched and recovered uniaxially,
regular, periodic folds are generally formed. That is,
10   for any given transverse section the distance between
adjacent peaks or adjacent valleys is relatively constant.

Fig. 3 shows a scanning electron micrograph of
the surface of a polybutylene/styrene-isoprene-styrene
(SIS)/polybutylene laminate backing of Example 6 which has
15   been stretched past the elastic limit of the outer skin
layers in the longitudinal direction and allowed to
recover to form a microstructured surface. The
microstructured surface corresponds to that shown
schematically in Fig. 2.
20   The microstructured surface consists of
relatively systematic irregularities whether stretched
uniaxially, as was the Fig. 3 laminate tape backing, or
biaxially. These irregularities increase the opacity of
the surface layers of the laminate, but generally do not
25   result in cracks or openings in the surface layer when the
layer is examined under a scanning electron microscope.

Microtexturing also affects the properties of
the formed tape. Uniaxial stretching will activate the
tape to be elastic in the direction of stretch. Biaxial
30   stretching will create unique surfaces while creating a
laminate tape which will stretch in a multitude of
directions and retain its soft feel if there is a
microtextured skin backside.

It has also been found that the fold period of
35   the microstructured surface is dependent on the core/skin
ratio, as shown in Example 3. The periodicity is also

indicative of the texture of the surfaces per Table II.
This is again another indication of the control possible
by careful choice of the parameters of the present
invention.

It has also been found that the manner in which
the laminate tape or backing is stretched effects a marked
difference in the texture of the microstructured surface.
For example, the extruded multi-layer laminate tape or
backing can be stretched uniaxially, sequentially
biaxially, or simultaneously biaxially, with each method
giving a unique surface texture and distinct elastomeric
properties. When the film is stretched uniaxially, the
folds are microscopically fine ridges, as per Fig. 3,
with the ridges oriented transversely to the stretch
direction.

When the laminate tape backing is stretched
first in one direction and then in a cross direction, the
folds formed on the first stretch become buckled folds and
can appear worm-like in character with interspersed cross
folds as in Fig 10. Fig. 10 is a laminate of PP/SIS/PP
with a core/skin ratio of 18 (Example 24). Other textures
are also possible to provide various folded or wrinkled
variations of the basic regular fold. When the film is
stretched in both directions at the same time, the texture
appears as folds with length directions that are random,
as shown in Fig. 6 (a laminate prepared as per Example 19A
with skin/core/skin thicknesses of 5/115/5 microns
respectively) or Fig. 11 (Example 24). Using any of the
above methods of stretching, the surface structure is also
dependent, as stated before, upon the materials used, the
thickness of the layers, the ratio of the layer
thicknesses and the stretch ratio.

The unique continuous microstructured surfaces
of the invention can be altered and controlled by the
proper choice of materials and processing parameters.
Differences in the material properties of the layers can
change the resulting microtextured skin, but it has been

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found that by the careful choice of the layer ratios,
total laminate film thickness, the number of layers,
stretch degree, and stretch direction(s) it is possible to
exercise significant control over the microstructure of
the laminate skin layer.

5

The degree of microtexturing of elastomeric
laminate backings prepared in accordance with the
invention can also be described in terms of increase in
skin surface area. Where the laminate shows heavy
textures, the surface area will increase significantly.

10

This is demonstrated for LLDPE/SIS/LLDPE(linear low
density polyethylene) laminates in Table VIII, Example 16.
In this example, as the stretch ratio increases so does
the percent increase in surface area, from the unstretched
to the stretched and recovered laminate; from 280 at a

15

stretch ratio of 5, to 530 at a stretch ratio of 12.
Generally the microtexturing will increase the surface
area by at least 50%, preferably by at least 100% and most
preferably by at least 250%. The increase in surface area
directly contributes to the overall texture and feel of

20

the laminate surface.

Increased opacity of the skin and hence the
laminate backing also results from the microtexturing.
Generally, the microtexturing will increase the opacity
value of a clear film to at least 20%, preferably to at

25

least 30%. This increase in opacity is dependent on the
texturing of the laminate with coarse textures increasing
the opacity less than fine textures. The opacity increase
is also reversible to the extent that when restretched,
the laminate will clear again.

30

It is also possible to have more than one
elastomeric core member with suitable skins and/or tie
layer(s) in between. Such multilayer embodiments can be
used to alter the elastomeric and surface characteristics
of the laminate.

35

Adhesive can be applied to the laminate backing
by any conventional method, such as: solvent coating, by

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methods such as reverse roll, knife-over-roll, gravure
wire wound rod, floating knife, or air knife; hot melt
coating such as by slot orifice coaters, roll coaters, or
extrusion coaters; and direct coextrusion during laminate
formation. The adhesive will generally be applied to the
as cast laminate backing or when the laminate is stretched
prior to recovery. Adhesives will preferably be applied
to or with the cast laminate unless it is an adhesive
which does not stretch to the extent that the laminate is
stretched. Although adhesive can be applied to a
microstructured surface, this is not as desirable in terms
of adhesive layer uniformity, ease of application or
adhesive bonding to the laminate. For most applications,
the adhesive will be applied continuously across the
laminate backing. This eases application and collection,
e.g. as a roll, and facilitates use. Adhesive can also be
applied to both faces of the laminate backing.

A unique advantage of a microstructured surface
formed after the adhesive is applied is the ability to
improve bonding of the adhesive layer to the tape backing.
It has been found that when the adhesive layer is in full
contact with a microstructured surface there appears to be
a mechanical priming that reduces adhesive transfer or
cohesive failures in the adhesive layer. This highly
advantageous feature is noted at even significantly higher
peel forces than the forces which cause these problems in
corresponding tapes without microstructured surfaces and
with the same adhesives.

The skin layer-to-core layer contact in the
stretched and activated film has been observed to vary
depending on the skin and core compositions. With certain
preferred constructions, the core and skin remain in full
contact with the core material, filling the folds formed
in the skin layers as shown in Fig. 2. This construction
is extremely durable and not as subject to delamination,
particularly when annealed following activation. A
variation of this continuous contact construction is also

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possible where the elastomer fills the skin folds but is observed to cohesively fail under the folds. It is believed this occurs with thicker and/or more rigid skins that expose the underlying elastomer to more concentrated stresses during relaxation. An entirely different skin/core adhesion mode is also possible. Namely, the core in some cases can completely retract from the skin under the folds, but remain sufficiently attached such that the skin does not delaminate (see Example 38, adhesive failure). This construction generally is not desirable as during use it is more easily subject to delamination as well as exposing the elastic core to air which may accelerate degradation of the elastomer.

The microstructured laminate tape is also highly conformable. This is an important feature as it allows the tape to be applied to a variety of surfaces, particularly to uneven surfaces or moving surfaces, and still give an adequate adhesive to substrate bond.

A further unique quality of the invention microstructured tape is its ability to exhibit a wide variation in adhesiveness to itself. The feature is particularly pronounced where both the adhesive layer and backside of the tape are microstructured. Namely, at higher rolldown pressures significantly greater levels of adhesive bonding are obtainable as compared to lower rolldown pressures. The differences in adhesive levels at differing rolldown pressures is more pronounced when a thinner adhesive is used, as shown in Figs. 14 (where 5 is the adhesive layer) and 16, as compared to a thicker adhesive, as shown in Figs. 15 and 17. With a thinner adhesive, the adhesive will more likely be microtextured.

It is believed that this variable self-adhesion phenomenon is related primarily to the relative amount of adhesive layer to tape backing contact area, which is potentially much higher where both the adhesive layer and the tape backside have microstructured surfaces. At low rolldown pressures, adhesive will tend to only contact the

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microstructure peaks on the backing. This low-contact
area will be exaggerated if th adhesive layer itself has
a peak and valley configuration. At higher rolldown
pressures, the adhesive, microtextured or not, will have a
tendency to be forced into the valleys of the backside
microstructure. This will tend to substantially increase
adhesive/backside surface contact and even permit
mechanical adhesive priming to the backside in some
circumstances (e.g., where the adhesive is flowable),
which also increases adhesion. With softer, more
flowable, adhesives the amount of pressure needed to
increase adhesive levels will generally be lower. The
degree and type of microstructuring will also be a
significant factor in determination of the rolldown
pressure variance in self-adhesion values (i.e., the
degree to which the microstructures will tend to
interlock). Multiaxially stretched laminates form more
random structures that may interlock better than
uniaxially stretched laminates. Placement orientation of
the adhesive to the tape backside also plays a significant
roll in the observed self-adhesion levels. The variation
in self-adhesive levels obtainable due to the
microstructured surface formed, on either the backside or
the adhesive face, will be quite wide due to the great
variability in surface structures that one can create in
the laminate skin layers, as discussed above.

        Adhesive thickness will also play a significant
roll in the observed variance of self-adhesion. Thicker
adhesives will result in less or no self-adhesion variance
due to any surface structure on the adhesive layer face.
However, thicker adhesive layers will tend to flow more
into a backside microstructure, which is a function of
adhesive viscosity.

        Thicknesses for thinner adhesives layers capable
of forming a surface microstructure will be dependent on
the particular microstructure formed. For example,
structures, such as those of Fig. 2, with folds having

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larger peak-to-valley distances and/or greater
peak-to-peak distances will be capable of forming adhesive
surface structures with thicker adhesive layers. Further,
the relative modulus values for the particular adhesive
will be a factor. Generally, an adhesive layer less than
5   30 microns and preferable less than 20 microns thick
should be sufficient to form a definite surface structure.

         Microstructured adhesive layers will have lower
peel values, to any substrate, than corresponding flat
adhesive layers at moderate application pressures. Again,
10   this is due to lower contact between the adhesive and the
substrate. This can result in peel values within the
range acceptable for a repositionable adhesive
formulation, such as those disclosed is U.S. Pat. No.
3,691,140 (Silver) and discussed in U.S. Pat. No.
15   4,684,685 (Shuman et al.). Generally, a 180° peel
adhesion from glass of less than 8 N/25 mm, preferably
less than 6 N/25 mm is characteristic of a good
repositionable adhesive formulation usable with most
substrates. For removable labels, a 180° peel from from
20   glass of 2.5-6.0 N/25 mm is most preferred. For tapes
cleanly removable from more delicate substrates, such as
newsprint, a 180° peel from glass of 0.5 to 2.5 N/25 mm is
most preferred. With the invention adhesive tapes, peel
values within these ranges are obtainable by varying the
25   adhesive layer thickness and the microstructure of the
skin layer(s). By varying these factors, one is able to
vary the amount of peak area of the adhesive layer
available for contact with a substrate. This will affect
repositionability as discussed in U.S. Pat. No. 3,857,731
30   (Merrill et al.). As peel values are dependent on this
available adhesive contact area, other factors which can
affect contact area will also influence the repositionable
character of the microstructured adhesive. For example,
the deformability of the skin layers will affect the
35   amount of peak adhesive surface able to contact a
substrate, as more deformable (e.g., softer skin material)

fold structures will tend to more easily flatten when subjected to higher application pressures.

For some tapes, a microstructured adhesive layer and/or a nonadhesive coated microstructured backside can function as a mechanical low adhesion backsize. For some tapes wound as a roll, this characteristic would be dependent on wind-up tension. A tape could thus be wound at a low windup tension and be readily removed by the user without the need of a chemical backsize coating. The same tape could then be applied by the user at a higher pressure and exhibit significantly higher self-adhesion values. This is an advantage over conventional backsizes which do not allow such wide adhesive level variability. Conventional backsized tapes exhibit relatively low self-adhesion regardless of the rolldown pressure. High self-adhesion is a significant advantage for tapes which are wound over themselves when used, such as insulating tape, medical tape, or the like, as discussed in U.S. Pat. No. 3,379,562. However, high self-adhesion is incompatible with forming the tape as a roll which is able to unwind.

Even activated tapes with high levels of adhesion (e.g., at zero peel angles) to a particular substrate can be removed. The high level of extensibility available with most invention tape constructions optionally coupled with the variability in adhesiveness caused by the microstructuring allows tapes with otherwise permanent adhesive peel levels to be removed. When stretched the tapes will tend to incrementally release at the leading edge of tape contact where the tape is being incrementally stretched. This leading edge release zone will travel incrementally down the tape until it is released from its substrate.

Many constructions of the invention adhesive tape can also be used as tamper indicating sealing tapes, which will indicate tampering due to the ability of the tape to change form. For example, as cast unactivated

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laminate tape can indicate tampering by at least three
mechanisms. First, it can stretch and indicate tampering
by, e.g., a change in opacity. Second, for tapes which
have low adhesion between the skin and core layers,
5   stretching will cause the layers to delaminate, again
indicating tampering. Third, cast laminates can be formed
which have relatively thick and/or rigid skins which will
cause the laminate to tear or break up the skin. Thinner
tape backings will tend to more easily stretch and
10   indicate tampering by the first mechanism. The actual
caliper required for a particular tamper indicating
application will depend on the force necessary to remove
or tamper with the tape on the particular package.
Generally, the thinner the overall laminate tape
15   thickness, the more sensitive it will be to tampering by
any of the above three mechanisms. Even the activated
tape can be tamper-indicating in some instances, as when
it is stretched, it will change its opacity value. This
change in optical properties can also be taken advantage
20   of by coloring the layers different colors. The change in
skin morphology and possibly skin/core contact mechanism
can change the additive effect (i.e., a color change in
the overall laminate) of the multicolored layers.
Further, with certain activated tapes, low adhesion
between the skin and core can be used to indicate
25   tampering by delamination. For example, the peel force of
tape removal for some tape constructions will cause the
skin layer to delaminate.

         With certain constructions, the microtextured
skin layers may tend to delaminate and/or the underlying
30   elastomer may tend to degrade over time. This tendency
is particularly problematic with ABA block copolymers.
Residual stress created during the stretching and recovery
steps of activating the material to its elastomeric form
can accelerate this process significantly. For those
35   constructions prone to such degradation or delamination, a
brief relaxing or annealing treatment following activation

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may be desirable. The annealing would generally b above
the glass transition point temperature (T_g) of the
elastomer, above the B block T_g for ABA block copolymers,
but below the skin polymer melting point. A lower
annealing temperature is generally sufficient. The
5   annealing will generally be for longer than 0.1 seconds,
depending on the annealing temperature. With commercial
ABA block copolymers (e.g., Kraton[TM] 1107), an annealing
or relaxing temperature of about 75°C is found to be
sufficient.
10   The laminate tape formed in accordance with the
above description of the invention will find numerous uses
due to the highly desirable properties obtainable. For
example, the microtexture gives the elastomeric laminate
tape backing a soft and silky feel. The tape can further
15   be non-necking. This renders the elastomeric laminate
tape particularly well suited for a variety of
commercially important uses as an elasticizing element
particularly in the garment area, where elastic webs are
used in areas to engage or encircle a body portion alone
20   or as part of a garment. Examples of such garments
include disposable diapers, adult incontinence garments,
shower caps, surgical gowns, hats and booties, disposable
pajamas, athletic wraps, clean room garments, head bands
for caps or visors or the like, ankle bands (e.g., pant
25   cuff protectors), wrist bands, and the like.
           Removability characteristics of the tape make it
useful as temporary tape, removable label stock, temporary
note pads or the like. With labels, it is often useful to
provide a non-adhesive coated strip to permit gripping the
30   label for removal. Writability improvements from
microtexturing also make the activated laminate tape well
suited for label stock and the like.
           The laminate tape can be extensively used in
disposable diapers, for example, as a waistband, located
35   in either the front or side portions of the diaper at
waist level, as leg elastic, as a soft outer cover sheet

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or in adjustable slip-on diapers, where the elastomeric
laminate could be used as, or in, side panels around the
hip that create a tight fitting garment or as a fastening
tab. The laminate tapes can be applied as continuous or
intermittent lengths by conventional methods. When
applied, a particular advantage of the laminate tape is
the ability to use thin elastomers with high stretch
ratios. This creates a great deal of gathering or shirr
when applied to the garment when stretched, which gives
the shirred portion a cushion-like feel.

Garments often are shirred to give a snug fit.
This shirring can be easily obtained by applying the
laminate while in an unstable stretched condition and then
affecting the shirr by application of heat. The
elastomeric laminate can be adhered to the garment by
ultrasonic welding, heat sealing and adhesives by
conventional methods.

The controlled relaxation obtainable by
adjusting the layer ratios, stretch ratio and direction,
and layer composition makes the elastomeric tape of the
invention well suited to high speed production processes
where heat activated recovery can be controlled easily by
hot fluids such as hot air, microwaves, UV radiation,
gamma rays, friction generated heat and infrared
radiation. With microwaves, additives, such as nickle
powder, aluminum flakes and iron whiskers, may be needed
to ensure softening of the skin to effect skin controlled
recovery.

The counter-balancing of the elastic modulus of
the elastomeric layer and the deformation resistance of
the skin layer also modifies the stress-strain
characteristics of the laminate tape. This also can be
modified to provide greater wearer comfort when the
laminate tape is used in a garment. For example, a
relatively constant stress-strain curve can be achieved.
This relatively constant stress-strain curve can also be
designed to exhibit a sharp increase in modulus at a

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pr determined stretch percent, i.e., the point at which
the skin was permanently deformed when activated as shown
in Fig. 5, line Y. Prior to activation, the laminate is
relatively rigid, line Z of Fig. 5, i.e., having a high
modulus imparted due to the skin layer. The non-activated
5 or non-stretched laminate is easier to handle and much
better suited to high speed production processes than
would be a conventional elastic. To achieve these
benefits, the skin can be either an inner layer, an outer
layer or both. In Fig. 5, line ZZ is the skin alone and
10 line X is the elastomeric layer alone.

        The elastomeric laminate tape is well suited for
use as a repositionable tape, wrapping tape, insulating
tape, label stock or general purpose tape. The heat
shrink character of the tape can also render it suitable
15 for heat shrink applications, particularly in view of the
conformable nature of the tape. The tape has the
advantage of the ability to form a natural LAB, ink
receptivity, mechanical adhesive priming and variable
adhesive levels.

20   The elastomeric laminate tape will also easily
electrostatically charge when rubbed. This ability,
coupled with the enclosed spaces, makes sheets of the
microstructured laminate tapes useful as dust wipes, or as
dust mats (e.g., in a clean room). Further, the polymer
25 skin will often attract and store oils. The tapes could
be formed into a multitude of stacked sheets, and as they
are removable, could be removed when used to expose an
underlying clean sheet.

        The following Examples are provided to
30 illustrate presently contemplated preferred embodiments
and the best mode for practicing the invention, but are
not intended to be limiting thereof.

        Examples 1-32 are illustrations of laminates
suitable for use as backings for the invention adhesive
35 tapes.

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EXAMPLE 1

A five-layer laminate was prepared from two
outer layers of 5.08 cm by 5.08 cm, 2000 molecular weight
polystyrene and two layers of 5.08 cm by 5.08 cm of 2 mil
(0.0508 mm) thick linear low density polyethylene (LLDPE)
5   film (Dow[TM] 61800, Dow Chemical Corp., Midland, MI) and a
core layer of 5.08 cm by 5.08 cm of 125 mil (3.175 mm)
thick styrene-isoprene-styrene (SIS) film (Kraton[TM] 1107,
available from Shell Chemical Company, Belpre, OH) by
heating at 160°C under 2000 pounds per square inch (140
10   kilograms per square cm) of a flat press. The resulting
film laminate was about 5 mil (0.127 mm) thick. The poly-
styrene layers were a processing aid to help form a
uniform layered film. The thin brittle polystyrene layers
of the laminate were peeled away, and a clear film re-
15   mained. After stretching the clear film by hand to 500%,
and allowing it to recover, a smooth and pleasing surface
was observed with the naked eye, and surprisingly, exami-
nation under a microscope disclosed a continuous, deeply
textured, microstructured surface. Since this sample was
20   uniaxially stretched, fine ridges were observed, oriented
transversely to the stretch direction, said ridges having
a height to width ratio of about 2 to 1.

EXAMPLE 2
25   A continuous coextrusion was carried out to
prepare a three-layer laminate with two outer skin layers
of LLDPE and a core layer of SIS using polymers as
described in Example 1. Three laminates of 8.5, 4.7, and
3 mil (215, 120 and 78 microns) thickness were prepared
30   using a Rheotec[TM] (Rheotec Extruder Co., Verona, NJ)
extruder to feed the SIS layer from a tee union into the
center of a cross union and a Berlyn[TM] (Berlyn Corp.,
Worchester, Mass) extruder was used to feed the two LLDPE
layers into the two opposite sides of the cross union and
35   then the three laminated layers of film were drawn from
the 425°F (218°C) die in widths of 18 inches (45.7 cm).

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The laminates had skin/cor skin thicknesses in microns of
20/175/20, 16/90/14 and 10/60/8, respectively, determined
under a light microscope. After the film was stretched
past the elastic limit of the outer skin layers, it
deformed and demonstrated a microstructured surface upon
recovery. When initially uniaxially stretched about 500%,
these laminates necked down, width wise, to about 40% of
their unstretched width. Upon subsequent restretching to
about 500%, the films surprisingly necked down very
little, as shown in Table I.

TABLE I

Sample		% Reduction in Width Thickness upon Restretching
78	microns	5.2
120	microns	3.2
215	microns	2.8

The films thus essentially remained constant in
width after initial stretching. Not all stretched films
will show this non-necking property. The non-necking is a
property of the unique unfolding of the stretched surface
layers of the present invention, and is a function of the
skin thickness and modulus, i.e., strength. This strength
must be high enough to prevent width contraction of the
core layer upon re-stretching. That is, it is a balance
of skin and core forces. Very soft or very thin skinned
materials, therefore, need to be thicker for the laminate
to possess this property.

EXAMPLE 3

A continuous coextrusion was carried out to
prepare three-layer laminates with two outer layers of
polypropylene and a core elastomeric layer of a
styrene-isoprene-styrene block copolymer. A 2 inch (5.1
cm) screw diameter Berlyn™ extruder was used to feed the
elastomer (Kraton™ 1107, Shell Chemical Company, Beaupre,

OH) and a Brabender™ 1.25 inch (3.18 cm) screw diameter
extruder (available from C. W. Brabender Instruments,
Inc., NJ) was used to feed the two polypropylene
(Escorene™ 3085, available from Exxon Corporation,
Houston, TX) layers into the Cloeren™ (Cloeren Co.,
Orange, TX) feedblock, and were extruded through a single
manifold 18 inch(46 cm) wide film die. The film was cast
onto a 60°F·(16°C) cast roll at 14.7 ft/min (509 cm/min)
at varying total caliper as described in Table II. Films
of varying outer layer thickness were prepared.

The films were tested for relaxation by
initially uniaxially stretching each sample by hand to
just short of its breaking point, which was generally
about 650%, releasing the sample, and observing any
recovery. Recovery after initial draw was then
categorized as instantaneous recovery (I), slow recovery
with time (T), heat required for recovery (H) and
permanent deformation (P), i.e. no significant recovery.
Results are shown in the following table.

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TABLE II

SAMPLE NO.	TOTAL SKIN THICKNESS (microns)	CORE THICKNESS (microns)	CORE THICKNESS SKIN THICKNESS	RECOVERY	TEXTURE OF LAMINATE
A	5	90	18	I	F
B	8	145	18	I	F
C	12	175	14.6	I	M
D	7	54	7.7	I	F
E	14	100	7.1	T	C
F	8	48	6	T−H	F
G	20	45	2.25	P	Smooth

Sample No.	% Change in Width upon Restretching sample	C.O.F.	Periodicity
A	1.4		−
B	2.8	0.59	10μ
C	2.0	0.67	45μ
D	2.0		
E	0	0.75	90μ
F	0		
G	Did not recover		

The texture of the laminate is evaluated both
visually and by touch after recovery and classified as
fine (F), medium (M), coarse (C) or smooth (no texture
discerned). The texture was also measured objectively in
samples B, C and E by the periodicity (distance between
folds) of the samples. It was noted that as the regular
folds get coarser, they also appear larger and more widely
spaced. Although the large folds are more subject to
having more random peak-to-peak distances, they are still
quite regularly spaced.

The samples were also tested for necking
characteristics expressed as % change in width upon
restretching of the sample. Although necking was not
significant for any of these samples, generally, as skin

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thickness fell and the core-to-skin thickness ratio rose,
necking increased.

        Periodicity and C.O.F. are also shown for
samples B, C and D which are both inversely related to the
core/skin thickness ratio. The original C.O.F. for the
samples was over 3.8, thus the microtexturing produced a
significant overall reduction of C.O.F.

EXAMPLE 4

        A multilayer laminate was prepared by laminating
cast laminates of polypropylene/Kraton^{TM}
1107/polypropylene prepared as in the previous example.
The total thickness of each cast laminate was 2.8 mil
(0.062 mm). The core/skin ratio was 12:1. The laminated
laminate was formed of 6 cast laminates in a hot press at
200°C at 140 kilograms per square centimeter pressure for
five minutes. The formed film was then cooled in a 21°C
water bath. The resulting laminate was 6 mil(0.15 mm)
thick and appeared like the cast film but thicker. After
stretching approximately 300% and instantaneous recovery,
the film displayed a coarse microtextured skin and
microtextured inner skin layers.

EXAMPLE 5

        A continuous coextrusion was carried out to
prepare three-layer laminates with two outer layers of a
70/30 by weight blend of poly(vinylidene fluoride)
(Solef^{TM} 1012, Solvay Co., France) and poly(methyl
methacrylate) (VO44, Rohm and Haas Corp., Bristol PA) and
a core layer of Kraton^{TM} 1107. A 2 inch(5.1 cm) diameter
Berlyn^{TM} screw extruder, at 10 RPM screw speed, was used
to feed the core layer polymer and a 2 inch(5.1 cm)
diameter screw Rheotec^{TM} extruder, at 25 RPM, was used to
feed the skin layer polymer blends into a Cloeren^{TM}
feedblock and the melt laminate was extruded through a
single manifold die, 18 inches(46 cm) wide (Extrusion
Dies, Inc., Chippawa Falls, WI), at 420 to 450°F(215 to

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232°C) onto a 78°F(26°C) cast roll at 17.0 or 15.3
revolutions per minute (RPM), respectively. The film
laminate thicknesses obtained were 5.5 and 6.0 mil (0.14
and 0.15 mm) with core/skin ratios of 6:1 and 7.5:1,
respectively.

5
          Both laminates were stretched 400% and allowed
to immediately recover. In each case, a laminate with a
fine glossy microtextured surface was obtained.

          EXAMPLE 6
10
          A continuous coextrusion was carried out to pre-
pare two distinct three-layer laminates with two outer
layers of a 50/50 blend of two polybutylenes resins,
Shell^{TM} 0200 and Shell^{TM} 0400, and a core elastomeric
layer of Kraton^{TM} 1107. A 2 inch (95.2 cm) diameter screw
15
Berlyn^{TM} extruder was used to feed the Kraton^{TM} 1107 at a
screw speed of 10 RPM. A 1.25 inch (3.18 cm) diameter
Brabender^{TM} screw extruder was used to feed the two
polybutylene blend layers at screw speeds of 10 and 12 RPM
into a Cloeren^{TM} feed block. The laminates were extruded
20
through a single manifold 18 inch (46 cm) wide film die at
430°F (221°C) onto a 60°F (16°C) cast roll at either 8.8
or 7.6 ft/min (2.7 or 2.3 m/min), maintaining a total
caliper of 0.003 inches (0.076 mm) for both samples. This
produced two films of varying outer skin thicknesses with
25
the same total laminate thickness. The core/skin ratios
were 13:1 and 5:1, respectively.
          Also, the same equipment was run at a
Brabender^{TM} extruder speed of 35 RPM and a cast roll speed
of 8.6 ft/min (2.6 m/min), all other conditions the same
30
as above, to give a 0.005 in (0.127 mm) thick laminate
(comparative) with thick overall skin layers, and a
core/skin ratio of 2.6:1.
          The texture for each sample was noted after each
laminate was stretched by hand just short of its breaking
35
point, about 4:1, and allowed to recover, the first two
runs instantly and the third (comparative) with heat. The

textures were classified as very fine, fine and none.
This data is shown in Table III below.

TABLE III

Brabender™ Speed (RPM)	Cast Roll Speed (cm/min)	Total Film Thickness (cm)	Texture
10	268	0.0081	very fine
12	232	0.0081	fine
35	262	0.013	none

EXAMPLE 7

A continuous coextrusion was carried out to
prepare five-layer laminates with two outer layers of
linear low density polyethylene, ethylene vinyl acetate
tie layers of Elvax™ 260(EVA) (available from Dupont
Corporation, Wilmington, DE) and a core elastomer layer of
styrene-isoprene-styrene block copolymer. A 2 inch(5.1
cm) screw diameter, 4D ratio Berlyn™ extruder was used to
feed the elastomer layer (Kraton™ 1107). A Rheotec™ 2
inch(3.18 cm) screw diameter extruder was used to feed the
two polyethylene layers, and a 1 inch(2.54 cm) screw
diameter 3M-made extruder was used to feed the two Elvax™
layers into a Cloeren™ feedblock.

The laminates were extruded through a single
manifold 18 inch(46 cm) wide film die at 375°F(190°C) onto
a 60°F(16°C) cast roll at varying total caliper or
thickness as described in Table IV. Films of varying
layer thickness were thus prepared. This example also
demonstrates how casting roll speed affects film
thickness.

The EVA tie layers add bonding strength between
the LLDPE outer layers and the SIS core layer, resulting
in a more durable laminate than such a film without the

EVA, yet does not interf re with the way the laminate
behaves with respect to surfac texture. This tie layer
is, of course, very thin compared to the other layers.

TABLE IV

PROCESSING CONDITIONS FOR SAMPLES

NO.	BERLYN+ RPM	RHEOTEC++ RPM	CASTING ROLL SPEED (RPM)	NIPP ROLL SPEED (RPM)	FILM THICK- NESS (microns)	SUR- FACE TEXT- URE*	1" EXT.' RPM
7A	30	8	15	15	132.0	F	24
7B	30	8	15	15	132.0	F	24
7C	30	8	7	7	272.0	MF	20
7D	30	8	4	4	508.0	C	20
7E	30	8	14	14	124.0	F	20
7F	30	8	25	25	71.0	VF	20
7G	30	8	48	48	25.4	SF	20

+ Berlyn^{TM} extruder temperature same for all samples:
   Zone 1=149°C, Z2=177, Z3=193, Z4=204, Z5=204, Z6=204

++ Rheotec^{TM} extruder temperature same for all samples:
   Zone 1=110°C, Z2=149, Z3=149, Z4=160

' 1" (2.54 cm) extruder temperature same for all runs:
   Zone 1=143°C, Z2=191, Z3=191

* F=Fine microtexture, MF=medium fine, VF=very fine,
   SF=super fine, C=coarse

     Since the extruder conditions were close to
constant for all of the above runs, the core thickness to
skin thickness ratio will be the same for all of the above
runs, approximately 13:1 as will be the core/tie layer
ratio at 30:1. Thus, it will be noted that the total film
thickness column of Table IV correlates exactly with the
surface texture column. The range of values goes from a
total film thickness of 1.0 mil(25 microns) and a
texture of super fine, to 20.0 mil(508 microns) and a
texture of coarse, all from a stretch of 5:1 and an

instantaneous recovery. Thus, it can be seen that the thicker materials give coarser textures and that by controlling the physical parameters, the texture can be controlled.

5   EXAMPLE 8

A three-layer LLDPE/SIS/LLDPE film was made as in the previous examples using a Berlyn^{TM} extruder with a screw speed of 20 RPM to feed the Kraton^{TM} 1107, and a Brabender^{TM} extruder with a screw speed of 17 RPM to feed
10 the Dow Chemical 61800 linear low density polyethylene (LLDPE) to a Cloeren^{TM} feedblock. The laminate was extruded through a single manifold 18 inch(46 cm) wide film die onto a casting roll at 85°F(29°C), and a speed of 13.7 ft/min(4.18 m/min) to give a laminate with a
15 core/skin ratio of 15.6:1 and a total thickness of 125 microns. The film was uniaxially stretched 4:1 and instantaneously recovered, the coefficient of friction of the film was measured from the stretched and recovered film, and compared to the unstretched film. The data is
20 shown in Table V. MD denotes Machine direction and TD denotes transverse direction.

TABLE V

Sample	Static COF	Dynamic COF
unstretched MD	4.5	4.2
unstretched TD	4.6	3.7
stretched MD	0.4	0.3
stretched TD	0.5	0.5

This data is indicative of the large drop in the coefficient of friction for the stretched film compared to its unstretched precursor and is also indicative of the
35 unique microtextured surface of laminates of the present invention.

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EXAMPLE 9

A three-layer laminate of the present invention was made using the set-up of Example 8. The Berlyn^{TM} extruder, operating at a screw speed of 10 RPM, was used to feed a polyurethane (Pellethane^{TM} 2102-75A from Dow Chemical) core material. The Brabender^{TM} extruder operating at a screw speed of 7 RPM was used to feed a blend of Amoco^{TM} 3150B(Amoco oil Co., Chicago IL) high density polyethylene (HDPE) and Kraton^{TM} 1107 in a 95:5 ratio, as the skin material, to the Cloeren^{TM} feedblock. The small amount of Kraton^{TM} 1107 was added to the skin layer to increase the adhesion of the skin layer to the core layer. The laminate was extruded through a single manifold, 18 inch(46 cm) wide, film die onto a casting roll at a temperature of 70°F(21°C) and a speed of 21 ft/min(6.4 m/min) to give a 69 micron laminate with a core/skin ratio of 13.7:1. The laminate exhibited a microtextured surface after stretching 600% and instantaneous recovery.

EXAMPLE 10

A three-layer laminate of the present invention was made using the set up of Example 8. The Berlyn^{TM} extruder operating at a screw speed of 60 RPM was used to feed a triblock copolymer elastomer of styrene-butadiene-styrene (SBS) (Kraton^{TM} 1101) as a core material, and a Killion^{TM}(Killion Extruder Co., Cedar Grove, NJ) extruder was used to feed a Dow^{TM} 3010 LLDPE material to a Cloeren^{TM} three layer die. The extrudate was cast upon a casting roll at a temperature of 85°F(29°C) and a speed of 41 ft/min(12.5 meters/minute). The resulting 5 mil(0.127 mm) thick film with a core/skin ratio of 8.9:1 was easily stretched 7.5:1 and upon instantaneous recovery a fine textured laminate was formed.

EXAMPLE 11

A thre -layer laminate of the present invention
was made using the set up of Example 4, with the Berlyn^{TM}
extruder feeding a Kraton^{TM} G 2703 styrene-ethylene
butylene-styrene (SEBS) block copolymer at a screw speed
5   of 20 RPM, and the Brabender^{TM} extruder feeding an Exxon^{TM}
PP-3014 polypropylene at a screw speed of 5 RPM, to a
Cloeren^{TM} feedblock. This material was then extruded
through a 18 inch(46 cm) film die onto a casting roll at a
temperature of 34°F(1.1°C). The film produced was easily
10   stretched 600% and formed a fine textured surface after it
was allowed to recover instantaneously. The layer
thicknesses determined under a light microscope were
15/162/12 microns skin/core/skin, respectively.

15   EXAMPLE 12

This example demonstrates the use of varying
skin and core materials. In all runs, the line conditions
were identical using a Cloeren^{TM} feedblock at
400°F(204°C). The core extruder was the Brabender^{TM}
20   discussed above with temperatures in zones 1-4 of 178,
210, 210 and 216°C, respectively. The die was at
400°F(204°C) and the casting wheel at 51°F(11°C).

TABLE VI

25

#	CORE	SKIN	CORE SKIN RATIO	% STRETCH	SHRINK-AGE	TEXTURE
12A	Kraton^{TM} 1107	ELVAX^{TM}	360 9.6	700	I	F
12B	Kraton^{TM} 1107	(Polyester) (Eastabond^{TM} FA-300)	4.4	600	I	F

12A in Table VI demonstrates that elastomers can be used
35   for the skin when a more elastic core is used and with
appropriate stretch for a 115 micron(u) film. 12B
demonstrates the use of a polyester skin in a 120 micron

film. The laminate designated 12B, despite the relatively
large core-to-skin ratio, was of a relatively fine texture
and instant shrink recovery. This is due primarily to the
low modulus of the polyester (compare to Example 3).
FA-300 is available from Eastman Cemicals Co., Kingsport,
TN.

EXAMPLE 13
         Nylon 66 (Vydyne^{TM} 21 of the Monsanto Co., St.
Louis, MO), the condensation product of adipic acid and
hexamethylene diamine, was used as the skin in accordance
with the procedure outlined in Example 8. The core was a
SIS (Kraton^{TM} 1107) block copolymer. The nylon and
Kraton^{TM} were extruded at 525°F(274°C) and 450°F(232°C),
respectively into a 500°F(260°C) die. A 4 mil(0.1 mm)
thick film was formed with a core-to-ratio of 18:1. A
microtextured surface formed after a 4:1 stretch and
instant recovery.

EXAMPLE 14
         In order to increase the tackiness of the core
and lower core layer modulus and decrease its viscosity, a
solid tackifying rosin Wingtack^{TM} (Goodyear) was blended
with Kraton^{TM} 1107 in ratios of 10/90, 20/80 and 30/70
using the arrangement of the previous example, in 91, 114
and 165 micron films, respectively. The die temperature
was 380°F(193°C) with the Kraton^{TM} blend fed at a rate of
18.5 pounds/hour(0.14 kg/min) and the polyethylene skin
(LLDPE; Dowlex^{TM} 2500, Dow Chemical Co., Rolling Meadows,
ILL) fed at a rate of 6 pounds/hour(2.72 kg/hr). The
core-to-skin ratios were 6.2:1. For all three Kraton^{TM}
blends, a fine microtextured surface of the laminate was
obtained when a 6:1 stretch was employed and gave instant
shrink recovery.

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EXAMPLE 15

The relationship between skin thickness and percent stretch to surface texture (measured by periodicity) was explored using a SEBS core (Kraton[TM] G1657) and a polypropylene skin (Exxon[TM] 3085). The Berlyn[TM] extruder was used for the core and the Rheotec[TM] extruder was used for the skin, fed into a Cloeren[TM] feedblock. A single-layer drop die was used at 420°F(216°C), the casting roll operated at 38.9 ft/min(11.9 m/min.) and 50°F(10°C). The results are shown in Table VII below.

TABLE VII

#	AVG. SKIN THICKNESS (μ)	CORE/ SKIN RATIO	STRETCH %	PERIODICITY (μ)	SHRINK MECHANISM
15A	14	6	600	29	I
			250	56	I
15B	17.5	6.1	550	39	I
			350		
15C	21	4.4	550	46	H
			350	71	H
15D	20	4.3	550	47	H
			300		
15E	23	3.7	500	63	H
			350	69	H

As the stretch percent increased for each sample, the periodicity decreased indicative of the finer microtexturing obtained. This shows that stretch percent can be used to vary the surface structure of the laminate.

Further, as skin thickness increased, so did the periodicity. In all samples, the core thickness was approximately constant at 85 μ's. Skin thickness on a constant core can thus be directly related to the surface texture obtainable. As can be seen in the above Table IV,

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for relatively constant stretch % as the skin thickness increased so did the periodicity. The thick skinned samples thus produced coarser textures. This can, of course, be used to manipulate the skin and hence laminate characteristics.

EXAMPLE 16

The sample tested was that prepared in Example 8 the stretch ratio was varied from 2:1 to 13:1.

TABLE VIII

Stretch ratio	Periodicity (μ)	% Area Increase
2	(random wrinkles)	
3	30	
4	12	
5	10	280
6	8	
7	7	
8	6.5	390
9	6	
10	5.5	
11	5	
12	4	530
13	3	

As can be seen from Table VIII, the relationship between stretch ratio and periodicity demonstrated in Example 15 holds up for this LLDPE/SIS/LLDPE laminate. As the stretch ratio increases, the periodicity decreases first rapidly, then slowly in a substantially exponential manner. Further, the increase in area increases with an increase in stretch ratio.

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EXAMPLE 17

The relationship between stretch, core/skin ratio and shrink mechanism was demonstrated using the procedure of Example 4 and Example 15 for polypropylene/Kraton[TM] 1657 (SEBS)/polypropylene laminates. The material was stretched at the rate of 5 cm/sec. and held for 15 seconds. The film was allowed to shrink for 20 seconds and then heat shrunk in a water bath for 5 seconds at 160°F(71.1°C).

The length of the film after shrink was then compared to the length of the film after the 20 second hold period and the length after stretch to determine the shrink mechanism in operation. The results of this comparison is shown in Table IX below.

TABLE IX

CORE/SKIN RATIO	STRETCH RATIO(S)	SHRINK MECHANISM
6.0	3.8/5.3/6.2	I
5.3	4.6/5.3	S
	6.5	I
5.1	4.3/5.0	H
	5.5	S
	6.8	I
4.8	4.2/4.0	H
	6.0	T
	6.5	F
4.0	4.0/5.2/6.0	H
3.7	4.2 – 6.8	H
3.4	4.0	N
	4.7 – 6.0	H

N = None, H = Heat, S = Slow time, T = Time, F = Fast time, I = Instant

Fast is when more than 15% recovery occurred at
5 seconds. Medium time is where greater than 15% recovery
occurred at 20 seconds. Slow time is where greater than
15% recovery was not noted until 60 seconds after stretch.

EXAMPLE 18

Polypropylene (Exxon[TM] 3145) was added to a
Kraton[TM] 1107 (SIS) elastomer as a modifier for the core
material. The skin used was an Exxon[TM] 3014 polypropylene
(PP). The cores prepared contained 5 and 10 percent
Exxon[TM] 3145 polypropylene by weight. The relationship
between stretch, the shrink mechanism and texture was
tested. The results are in the following Table.

TABLE X

Core/Skin Ratio = 6.9, 112 microns thick, 10% PP in Core

% Stretch	320	410	510	590
Shrink Mechanism	None	None	Heat	Heat
Texture	-	-	Coarse	Coarse

Core/Skin Ratio = 8.0, 125 microns thick, 10% PP in Core

% Stretch	280	380	480	570
Shrink Mechanism	None	None	Heat	Heat
Texture	-	-	Coarse	Coarse

Core/Skin Ratio = 8.8, 84 microns thick, 5% PP in Core

% Stretch	270	320	400	500	590
Shrink Mechanism	Heat	Heat	Heat	Slow Time	Fast Time
Texture	Coarse	Coarse	Coarse	Med	Fine

As can be seen, the addition of PP to the core
decreases the shrinkability of the laminate. The
polypropylene appears to reduce the elasticity of the core

thereby permitting the restraining forces of the skin to more easily dominate the elastic strain imposed by the deformed elastic core.

EXAMPLE 19

5

The effect of adding a stiffening aid, polystyrene, to an elastomeric core material was tested. The skin comprised a linear low density polyethylene (Dowlex™ 6806). The core was a blend of SIS (Kraton™ 1107) and polystyrene (500PI or 685W, both from Dow

10

Chemical Co.). All samples were of a 3-layer construction (skin/core/skin) with a total thickness of 4.5 mil(0.11 mm) and a core/skin ratio of 8:1. All samples were then stretched 400% and instantaneously recovered. Tensile curves were then generated which demonstrated that the

15

laminates became stiffer with increasing polystyrene content (as shown in Fig. 9 (T-N), shown also in the following Table XI.

20

TABLE XI

SAMPLE #	% P.S.(Type)	5% YOUNGS MODULUS(kg/cm$_2$)
19A(T)	0	11.5
19B(S)	10 (500 PI)	20.7
19C(R)	30 (500 PI)	29.4
19D(P)	40 (685 W)	68.6
19E(N)	50 (685 W)	188.4

25

EXAMPLE 20

30

In this example, the effect of the addition of Wingtack™ tackifier to the core elastomer was investigated. The laminate material of Example 14 was compared to a 3-layer laminate (20) comprising LLDPE/Kraton™ 1107/LLDPE. Both samples were 4 mil(0.10 mm) in total thickness with core/skin ratios of

35

approximately 8:1. These materials were of the instant shrink type when stretched from 4:1 to 13:1.

TABLE XII

EXAMPLE	5% YOUNGS MODULUS
20 (Comp)	109 kg/sq.cm.
14	47.9 "

As can be seen from Table XII, the use of a
viscosity reducing aid/tackifier has the opposite affect
as the addition of a polystyrene stiffening aid.

EXAMPLE 21

A two-layer laminate of a core and one skin
layer was formed of Kraton^{TM} 1107 (SIS)/Exxon^{TM}
polypropylene 3014. A Berlyn^{TM} extruder operating at 6
RPM was used with the polypropylene and a Killion^{TM}
extruder operating at 125 RPM was used for the Kraton^{TM}.
The polymers were fed to an 18 inch(45.7 cm) 440°F(227°C)
Cloeren^{TM} die with one manifold shut down. The resulting
film was cast on a roll at 60°C and rotating at 35.2 RPM.
The laminate formed was 2 mil(0.051 mm) thick with a
core/skin ratio of 2.5:1 and exhibited a coarse
microtexture when stretched 5:1 and allowed to recover
instantly. Necking on subsequent restretching was only
2.5%.

EXAMPLE 22

A laminate was formed having skins of different
compositions. The elastic core was Kraton^{TM} 1107 with one
polyethylene (Dow^{TM} LLDPE 61800) and one polypropylene
(Exxon^{TM} 3085) skin. The core was extruded with a
Berlyn^{TM} extruder, while the skins were extruded with
Rheotec^{TM} and Brabender^{TM} extruders, respectively. The
Cloeren^{TM} die was at 350°F(177°C) and the casting roll at
60°F(16°C). Two films were formed. For the first, the
extruders operated at 20, 8 and 26 RMP's, respectively,
while the cast roll operated at 17.3 RPM to form laminates

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with core/skin ratios of 18:1. The sample formed was
instant shrink at a 5:1 stretch, with a fine microtexture.
For the second film, the extruders and cast roll operated
at 10, 16, 26 and 14.2 RMP's, respectively, to form a
laminate with a core/skin ratio of 18:1. The second
laminate was also instant shrink at 5:1 stretch yet
exhibited coarse surface texture. Both laminated were 4.0
mil(0.1 mm) thick.

EXAMPLE 23
        The laminate tape backing of Example 16 was
stretched in a first direction by 8:1 and sequentially in
a cross direction by 4:1. This laminate was of the
instant shrink type.

EXAMPLE 24
        The laminate of Example 3A was stretched in one
first direction at 4:1 and sequentially in a cross
direction by 4:1. This laminate was of the instant shrink
type. The texture formed is shown in Fig. 10.

EXAMPLE 25
        The laminate of 3A was stretched simultaneously
biaxially at 4:1 by 4:1. The laminate recovered
instantly. The core/skin thickness of unstretched
laminate was 90/5 microns, respectively.

EXAMPLE 26
        A three-layer laminate of
polypropylene/SEBS(Kraton^{TM} 1657)/polypropylene used in
Example 17 was tested for writability. The core/skin
ratio was 5:1 with a total laminate thickness of 5
mil(0.13 mm). The film was stretched to 5:1 and allowed
to recover. The writability before and after stretching
is shown in Figs. 7 and 8, respectively.

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EXAMPLE 27

A series of LLDPE/SIS/LLDPE laminates were
compared for their non-necking characteristics, as shown
in Table XIII below.

TABLE XIII

#	C/S RATIO	STRETCH RATIO	THICKNESS (microns)	% WIDTH CHANGE
A	8.75	5:1	215	2.8
B	6.0	5:1	120	3.2
C	6.7	5:1	78	5.2
D	15.3	7:1	100	10.0
E	21.2	8:1	132	33.3
F	PURE SIS	5:1		50.0
G	"	7:1		62.5
H	"	8:1		70.8

The first 3 examples are from Example 2, and SIS
was also tested for comparison purposes. As the C/S ratio
and stretch ratios rose, the problems with necking
increased.

EXAMPLE 28

The use of adhesive cores was demonstrated.
First a copolymer of isooctyl acrylate (IOA) and acrylic
acid (AA) in monomer ratios of (90/10) was used as a core
with polypropylene (Exxon[TM] 3014) and PET (intrinsic
viscosity 0.62) as the skins in the first two examples.
The IOA/AA copolymer was prepared in accordance with U.S.
Patent No. 4,181,752. The core/skin ratios and total
thicknesses were 20 and 10, and 22 mil(0.56 mm) and 6
mil(0.15 mm) before lamination for the PP and PET
examples, respectively. The laminates were cured for 5
minutes using a 15 watt UV light to cure the cores. The
PP skin embodiment was an instant shrink at 500% stretch

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while the PET skin embodiment was a heat shrink laminate
at 400% stretch.

PET was also used as a skin layer for a Kraton^{TM}
1107 (56 parts) Wingtack Plus^{TM} (35 parts) and Wingtack^{TM}
5 10 (9 parts) core with a core/skin ratio of 83:1 and a
total thickness of 25.6 mil(0.65 mm) before lamination.
This laminate was of the instant shrink type at 400%
stretch.

10 EXAMPLE 29
This example demonstrates skin controlled
relaxation in the heat shrink region and control of the
heat shrink mechanism by % elongation and core/skin ratio.
A series of 5 mil(0.12 mm) laminates were made with a core
of Kraton^{TM} 1107 (89 parts) poly(alpha-methyl)styrene (10
15 parts) and Irganox^{TM} (Ciba-Geigy Corp., Hawthorne NY) (1
part-antioxidant). The skins were polypropylene (Exxon^{TM}
3085). A Berlyn^{TM} extruder was used for the core and
Rheotec^{TM} extruders for the skin using a Cloeren^{TM} 3 layer
feedblock and a 18 inches(45.7 cm) film die. The cast
20 wheel temperature was 80°F(27°C) with the speed determined
by the core/skin (C/S) ratio and the skin extruder speed.
The shrink mechanism as a function of C/S ratio and %
stretch is shown in Fig. 12. Fast is when more than 15%
recovery occurred at 5 seconds. Medium time is where
25 greater than 15% recovery occurred at 20 seconds. Slow
time is where greater than 15% recovery was not noted
until 60 seconds after stretch.

Skin control of the temperature of activation
for the heat shrink material is demonstrated in Fig. 13.
30 The temperature of activation is defined as the
temperature required to achieve 50% or 90% of the recovery
obtainable. Lines V and W represent samples with
core/skin ratios of 4.71 and 4.11, respectively. As is
seen, as the core/skin ratio went down the temperature of
35 activation (both T_{a-90} and T_{a-50}) went up, indicating a
skin controlled relaxation. In this Figure, the 100%

value is defined as the % shrinkage at 160°F(71°C), which
for most practical purposes was the upper limit of
available recovery. The points below 80°F(27°C) are the
amounts of preactivation shrinkage for each example.

Three samples were also tested to measure the
increase in opacity from the unstretched clear film as
seen in Table XIV below.

TABLE XIV

CORE/SKIN RATIO	% STRETCH	TEXTURE	SHRINK MECHANISM	OPACITY AS CAST	OPACITY ACTIVATED
4.71	300	C	H	2.42%	30.4%
4.97	700	F	I	2.08	37.5
5.0	300	C	H	3.40	35.8

* The core had a 1/2% blue pigment.

EXAMPLE 30

A foamed core three-layer film was made. The
skins were Dow[TM] LLDPE 6806 and the core was 99.5%
Kraton[TM] 1107 with 0.5% AZNP 130 blowing agent (Uniroyal
Chemical Co., Naugatuck, Conn). Total film thickness was
20 mil(0.5 mm). The skins were 2.0 mil(0.05 mm) thick
each. The foamed core specific gravity was 0.65 as
compared to unfoamed Kraton[TM] specific gravity of 0.92. A
three-layer coextrusion die was used. This was an instant
shrink sheet exhibiting a coarse texture at about 300%
stretch.

EXAMPLE 31

The film from Example 2 with a core/skin ratio
of 6:1 was characterized for its unstretched and stretched
modulus value, the results of which are shown in Fig. 5; X
is the Kraton[TM] 1107 elastomer alone, ZZ is the
polyethylene skin alone, Z is the laminate as cast and Y
is the laminate after stretching to 500% and recovery.

EXAMPLE 32

        The film laminate of certain examples were
examined to determined the contact mechanism between the
skin and core layers. The stretched and activated samples
were cut with a razor blade on a hard surface. The
samples were then examined at the cut edges with a
scanning electron microscope. The core/skin contact was
then determined visually with the results summarized in
Table XV below.

                          TABLE XV

                                    Stretch
Ex   Composition   Ratio   Comments
 5   PVDF+PMMA/SIS/PVDF+
PMMA   2.2   Elastic cohesive failure
 6   PB/SIS/PB   3   Elastic cohesive failure
 7   PE/EVA/SIS/EVA/PE   5   Adhesive failure
12A EVA/SIS/EVA   4   Adhesive failure
12B FA300/SIS/FA300   7   Adhesive failure
19E PE/SIS+PS/PE   3   Some voids
 8   LLDPE/SIS/LLDPE   3   Filled
                                     5   Filled
                                     7   Filled
15A PP/SEBS/PP   4   Filled
15C PP/SEBS/PP   5.3   Elastic cohesive failure
 A   PP/SIS/PP   5.0   Filled

        New sample A corresponds to Example 29. Sample
A had approximately the caliper of the Example 29 samples
with a core/skin ratio of 5.1 and was a heat shrink
laminate.

COMPARATIVE EXAMPLE 1

A three-layer film of Dow[TM] LLDPE 2517
(Polyethylene)/Pebax[TM](Autochem Co, France) 3533/LLDPE
2417 was made. The film was formed by pressing three
precursor films together at 400°F(204°C) and about 2000
5   pounds of pressure(140 kg/sq.cm) for 5 minutes. The film
formed was 5 mil(0.13 mm) thick with a core/skin ratio of
12.7. The laminate was stretched 400% (from 1 to 5 cm).
The stretched laminate then contracted to 3.2 cm (36% of
stretched length) at room temperature. The relaxed
10 laminate was then heat shrunk by 180°F(82°C) air and it
contracted to 1.5 cm (53% of relaxed length). An edge of
the sample was then cut and observed for microtexturing.
No folds were observed at 1000x magnification.
Microscopic bumps, probably formed by recompression of the
15 cover layer, and skin delamination was observed. The
C.O.F. and opacity for the cast laminate was 0.901 and
2.77% while that for the relaxed activated laminate was
0.831 and 12.4%, respectively.

20 EXAMPLE 33

The tape constructions described in Table XVI
were prepared with the laminate backing produced in
accordance with the above described coextrusion techniques
with the adhesive layer applied as disclosed. Adhesive was
25 applied to the polypropylene side of the laminate. These
tapes were then tested for properties such as peel from
glass, peel from a microtextured tape backing (e.g., from
itself), writability and conformability.

Conformability is a test of the force necessary
30 for a substrate to deform into a curved surface using a
matching bar. Conformability was tested using a
Handle-O-Meter[TM] (Model 210) available from Thwing-Albert
Instrument Company, Philadelphia, Pennsylvania. The test
was run with the film parallel with the slot in the machine
35 direction (M.D.) of the film and the cross direction of the
film. The film width in both cases was 4 inches(10.26 cm)

and the slot width was set at 1/4 inch(0.635 cm). The test
was run with unstretched laminate, laminate uniaxially
stretched and recovered in the M.D. and laminated biaxially
stretched and recovered in the M.D. and C.D.

5   As summarized in Table XVIII, conformability is
the force necessary to force the laminate fully into the
slot with a corresponding bar. For uniaxially (M.D.)
stretched films the formation of microstructure generally
made the laminate more conformable to deformation in the
machine direction yet reinforced the laminate to

10   deformation in the cross direction (C.D.), i.e., made it
more rigid. The result is a laminate having highly
asymmetrical conformability. This is useful for a tape that
is to be attached to a surface with a two dimensional curve
(e.g., a pipe) where conformability in the flat direction

15   is unneeded or undesirable.

          For a multiaxially stretched laminate,
conformability increases in both the M.D. and C.D.

          The peel tests from glass and from the tape
backsize were both performed according to ASTM 180° Peel

20   Test D 3330-87 as reported in Table XVII. Disposable
glass slides cleaned with ethyl acetate were used once for
each reading. The tapes in the backsize test were placed
M.D. to M.D. A 5 lb(2.3 kg) roller was used to adhere the
tapes, with one pass at 90 in/min(2.3 m/min) with a 1 min

25   dwell time. The tape was then attached to the jaw of an
adhesion testing machine with a lower platen speed of 2.3
meters/min (90 in/min). Two second average readings were
taken. In Table XVIII, the numbers in parenthesis are
readhesion tests, where the sample originally peel tested

30   is readhered and retested for peel.

          Writability was determined visually on a scale of
poor (P), fair (F), good (G), very good (VG), and excellent
(E). The ink was a water-based composition from a broad
tip pen applied at normal hand pressure. Poor (P)

35   writability indicates that the ink beaded immediately and
easily wiped off the surface. Fair (F) indicates that the

ink beaded up over time and could be partially wiped off.
Good (G) indicates that the ink could not be wiped off, but
that there was some blurring of the lines drawn. Very good
(VG) indicates that ink could not be wiped off and that
5   only a small amount of blurring occurred. Excellent (E)
indicates that the ink could not be wiped off and that
there was no perceivable blurring of the lines.

        Writability appeared to clearly improve with
uniaxial stretching and even more so with biaxial
10   stretching.

        Readhesion peel tests are second peel tests run
on the same tape sample used in the first corresponding
test. This is a measure of the repositionability of the
tape.

        The shrink mechanism, repositionability, and
15   tamper indication mechanism of each tape sample is
disclosed in Table XIX.

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TABLE XVI

EXP No.	CORE Comp.	CORE Thick	SKIN Comp.	SKIN Thick	TIE Comp.	TIE Thick	Coat	ADHESIVE Comp.	ADHESIVE Thick
A	Kraton™ 1107	100μ	Polypropylene(P.P.) (3085)	7.5μ	—	—	I	X	9.0μ
B	"	"	"	7.5 "	—	—	I	X	14.0
C	90% " 10% PAMS 18-210	75	"	10.0 / 10.8	—	—	I	X	10.0
D	Kraton™ 1657	100	"	25 / 25	—	—	I	X	37.5
E	Kraton™ 1107	125	"	6.25 / 6.25	—	—	II	Y	37.5
F	Kraton™ 1107	75	Polyethylene(P.E.) 3520	7.5 / 7.5	—	—	I	X	14.0
G	85% Kraton™ 1107 15% P.S. 685-26W	70.0	P.E. 6806	18.8 / "	EVA260 "	5.0 / 5.0	III	Y	37.5
H	Kraton™ 1107	37.5	P.E. 3010	12.5 / "	EVA260 "	5.0 / 5.0	IV	Z	12.50
I	Kraton™ 1107	90.0	P.P. 3085	9.3 / 9.3	—	—	I	X	12.5
J	"	92.5	P.E. 61800 P.P. 65F53	15.0 / 15.0	—	—	III	Y	37.5
K	"	70.0	P.P. 15486	37.5	—	—	X	W	37.5
L	P.U. 2363-75A	18.75	50% PP 65F54 25% PB 0200 25% EVA 40W	22.5 / 22.5	—	—	I	X	15.0
M	Kraton™ 1107	175.0	70% Solvay™ 1008 30% PMMA VM100	12.5 / 12.5	—	—	III	Y	37.5
N	"	"	"	12.5 / 12.5			XI	Y	37.5
O	"	75	Polyester FA300 50% PB 0200	22.5 / 10.0			I	X	22.5
P	"	70.0	50% PB 0400 +CaCO₃ contaminant	10.0			III	Y	37.5

TABLE XVI cont...

EXP No.	CORE Comp.	Thick	SKIN Comp.	Thick	TIE Comp.	Thick	Coat	ADHESIVE Comp.	Thick
Q	"	55.0	EVA 260	10.0 10.0			III	Y	37.5
R	"	50.0	PP 3085	5.0 5.0			XII	V	55.0
S	80% PU-2352 -70A and 20% EVA 40W	65.0	PP 65F54	10.0			III	Y	37.5
T	Kraton™ 1107	150.0	50% PP 4092 and 50% Mineral Oil	50.0			III	Y	37.5
U	"	55.0	PS 685-26W	7.5 7.5			III	Y	37.5
V	P.U.2102-75A	75.0	P.E. 3150B 5% Kraton™ 1107	5.0 5.0			III	Y	37.5
W	Kraton™ 1107	227.5	PE 2517	20.0 20.0	EVA 260 ""	7.5 7.5	XIII	X	50–12.5μ

PAMS 18-210; Polyalphamethylstyrene 18-210 from Amoco, Chicago, IL.
Polyethylene 3520 and 3150B; available from Amoco, Chicago, IL.
EVA 260 and 40W; ethylenevinylacetate from E.I. DuPont de Nemours Co., Wilmington, DE.
P.S. 685-26W; polystyrene 685-26W available from Dow Chemical Co., Midland, MI.
P.E. 3010, 61800, 6806, and 2517; polyethylene from Dow Chemical Co., Midland, MI.
PP (polypropylene) 65F53 and 65F54; available from Himont U.S.A., Inc., Wilmington, DE.
polypropylene 15486; available from Charles B. Edwards, Minneapolis, MN
PB 0200 and 0400; polybutylene availalbe from Shell Chemical Co.
Solvay™ 1008; polyvinylidenefluoride availalbe available from Soltex Polymer Corp., Houston TX
PMMA; VM100 polymethylmethacrylate available from Rohm & Haas, Philadelphia, PA.
Polyester FA300; available from Eastman Chemical Products, Inc., Kingsford, TN.
PU 2352-70A; polyurethane available from DuPont
PP 3085 and 4092; available from Exxon Chemical Co.
PU 2102-75A; polyurethane available from Dow Chemical.

X : 40% isooctyl acrylate-acrylic acid (IOA-AA) 95.5/4.5 and 60% Foral™ 85, Hercules, Wilmington, Del.

Y : 3M 9671SL, available from 3M Corp., St. Paul, MN.

Z : 50% Kraton™ 1107 and 50% Wingtack™ Extra with antioxidants

W : IOA-AA (94.5-5.5)

V : 96% IOA-AA (90-10) and 4% Irgacure 651, Ciba Geigy Corp. Hawthorne, NJ

I : solvent coat from a solution of two parts heptane to 1 part isopropyl alcohol onto the cast film

II : laminate to stretched film

III : laminate to cast film

IV : hot melt coat at 350°F (177°C)

X : coextrusion

XI : laminate to microtextured film

XII : coated onto cast film and U.V. cured for 5 min. at 15 watts

XIII : solvent coat microtextured film from 2 parts heptane to 1 part IPA

In Table XV of the solvent coated samples, sample I was dried in 90°F oven for 1 min. All other solvent coated samples (A-D, F, L, O and T) were dried at room temperature for 24 hours.

TABLE XVII

Sample Number	Draw Ratio	180° Peel from Glass (N/25mm)			180° Peel from backside (N/25mm)		
		As Cast Peel	Uniaxed Peel	Biaxed Peel	As Cast Peel	Uniaxed Peel	Biaxed Peel
A	7.5	4.96	1.31 (1.32)	–	–	–	–
B	7.5	3.74	1.38 (1.59)	3.90 (3.51)	1.58	0.73	0.65
C	5.0	2.51 A.T.	0.46 (0.46)	–	1.93	0.48	–
D	6.0	16.35	11.18 (9.07)	–	10.32	5.92	–
E	7.0	6.91 A.T.	9.72 (9.76)	–	2.54	5.52	–
F	9.0	2.21	1.69 (1.73)	–	1.72	1.09	–
G	7.5	7.77	3.92 (3.77)	–	–	–	–
H	4.5	10.15	5.41 (4.36)	–	–	–	–
I	5.0	7.26	5.22 (4.99)	0.87 (0.86)	1.46	2.50	2.65
J	3.5	9.75	9.88 (9.37)	–	4.32	5.78	–
K	6.5	5.97	3.92 (4.42)	–	–	–	–
L	3.0	6.07 A.T.	4.94 (6.33)	–	1.58	9.06	–
M	3.0	6.88	7.78 (7.80)	–	3.82	3.75	–
N	3.0	7.24	7.24 (7.68)	–	–	–	–
O	6.5	4.45	3.55 (3.03)	–	2.88	1.15	–
P	2.0	8.14	7.67 (8.32)	–	2.42	3.22	–
Q	4.5	4.93	5.63 (5.09)	–	2.05	7.99	–
R	5.5	7.00	5.57 (5.38)	–	–	–	–
S	0	11.77D	–	–	–	–	–

TABLE XVII cont...

Sample Number	Draw Ratio	180° Peel from Glass (N/25mm)			180° Peel from Backside (N/25mm)		
		As Cast Peel	Unlaxed Peel	Blaxed Peel	As Cast Peel	Unlaxed Peel	Blaxed Peel
T	0	2.69B	–	–	–	–	–
U	0	0.14D	–	–	–	–	–
V	4.0	12.35D	–	–	–	–	–
W	7.0		1.45 (1.71)	0.29 (0.27)	–	0.16	0.17

D : delaminate

AT : adhesive transfer

B : breaks

TABLE XVIII

Water Based Ink

Exp #	Writability			Conformability (grams)					
	C	U	B	Cast MD	Cast CD	UMD	UCD	BMD	BCD
A	P	F							
B	P	F	VG	106	96	146	17		
D				228	237				
F	P	G							
G				98	106	78	10		
H				22	23	44	4		
I	P	VG	E	102	105	76	34	15	9
J	P	VG		49	64	29	10		
K	P	F							
L	P	G		19	25	12	5		
M	P	G							
O	P	G		593	599	158	44		
P	P	VG		52	58	19	8		
Q	F	G							
S				83	70				
T				753	698				
V				30	35				
W	F	VG	VG	445	446	517	100	137	61

TABLE XIX

EXP #	SHRINK MECHANISM	TAMPER MECHANISM	REPOSITIONABILITY
A	I	rimple	Y
B	I	"	"
C	H	"	"
D	T	"	"
E	I	"	"
F	"	"	"
G	"	"	"
H	"	"	"
I	"	"	"
J	"	"	"
K	"	"	"
L	"	"	"
M	"	"	"
N	"	"	"
O	"	"	"
P	"	"	"
Q	"	"	"
R	"	"	"
S	"	delaminate	N
T	"	tear	N
U	"	delaminate	N
V	"	"	"
W	"	derimple	Y

EXAMPLE 34

Sample I of Example 33 was further tested for
peel adhesion at 90° and 0° as shown in Table XX. When the
tape was removed from glass, it partially stretched with a
90° peel and fully stretched (i.e., to its natural draw)
with a 0° peel. Generally, the 90° peel was less than the
corresponding 180° peel except it was significantly higher
for the biaxial peel from glass and slightly higher for the
peel from backside test. It is believed the low 180° peel
for biaxially stretched film is due primarily to the fine
texture and high surface area that is formed with the
sample. This will result in a low contact surface to glass
at moderate rolldown pressures. In contrast, the
microstructured backside will tend to intermesh with the
microtextured adhesive layer and correspondingly will yield
a higher peel from itself. It is believed that this
intermeshing of microstructures is also responsible for the
comparatively high peel from backsize values for both 90°
and particularly 0°.

Table XX

Peel (N/25mm)

From Glass[1]	90°	0°
Cast peel	3.60	10.30
Readhesion	2.59[2]	6.64[3]
Uniaxed Peel	3.26	6.64
Readhesion	2.66	6.16
Biaxed Peel	2.47	
Readhesion	2.22	

From Backside	90°	0°
Cast Peel	1.77	6.87[4]
Uniaxed Peel	2.52	16.74
Biaxed Peel	2.78	

[1] All peel values are in Newtons/25 mm
[2] The tape stretched slightly when removed the first time
[3] The tape fully stretched when removed the first time
[4] The tape broke

EXAMPLE 35

        Samples I and W were further peeled tested at 0°,
90° and 180° varying the rolldown force used to adhere the
tape to the substrate from which it was peeled. The same
ASTM test as described in Example 33, using a IMASS[TM] 3M90(
available from IMASS Inc., Hingham, MASS). However, tape
was applied and tested first with a 5 lb(2.3 Kg) roller at
90 in/min(2.3 m/min) with only one pass and tested second
with a 10 lb(4.5 Kg) rolldown. The results in Newtons/25
mm are shown in Table XX.

        The tapes of samples A, B, C and D were prepared
using the laminate backings of samples I and W of Example
32 for (A and B) and (C and D), respectively. The adhesive
system applied was X of Example 32 applied by solvent
coating in a solution of two parts heptane and one part

isopropyl-alcohol. Samples A and C had an adhesive layer thickness of 22.2μ, while that for sample B and D was 29.6μ.

Again, a wide variation in adhesive values were obtained for the stretched and activated tape lamination.

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The variations are due to the microstructure formed and final adhesive layer thickness. All the samples were solvent-coated and dried at room temperature for 24 hours. However, one generally noted trend is that the relative increase in peel was much higher for activated tape than

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that for cast tapes when the rolldown pressure was increased (excluding the cases where there was adhesive transfer(AT) or delamination(D)).

Table XXI

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Example No.	0°		90°		180°	
A on glass	51b	101b	51b	101b	51b	101b
Cast	16.5AT	15.9ATD	3.4AT	1.4AT	3.6AT	2.5AT
Uniax	13.2AT	13.4ATD	3.5	4.2	1.2	3.0
Biax	4.8D	10.7D	4.1	4.5	0.9	1.2
A on A						
Cast	>18.2	16.6	1.1	1.2	1.3	0.9
Uniax	7.1	11.2	2.1	3.6	2.1	2.7
Biax	2.8	2.8	2.5	3.7	0.3	0.4
B on glass						
Cast	10.2	11.9ATD	2.0AT	3.3AT	2.9AT	3.0AT
Uniax	22.9	26.4	2.3	2.4	5.0	5.1
Biax	6.0	6.8	1.9	2.5	1.1	1.9
B on B						
Cast	17.6AT	15.7ATD	0.9	0.7	1.0	0.9
Uniax	6.3	9.1	0.9	1.3	2.0	2.3
Biax	6.8	8.6	1.0	1.5	1.4	2.6

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C on glass
Cast	12.6AT	>18.2AT	0.6	0.7	2.0AT	1.0AT
Uniax	14.5AT	9.7	0.7	1.4	1.9	0.5
Biax	10.3	10.1	0.2	0.5	0.8	0.9

C on C
Cast	13.5	17.5	0.3	0.4	1.1	1.0
Uniax	9.1	9.2	0.2	0.5	0.6	0.8
Biax	0.9	2.2	0.06	0.4	0.2	0.2

D on glass
Cast	>18.2AT	>18.2AT	7.0AT	5.9AT	8.1AT	8.7AT
Uniax	34.4AT	16.5AT	6.8	7.9	9.4	10.9
Biax	17.1	>18.2	6.0	6.1	6.2	7.1

D on D
Cast	>18.2	Broke	0.9	1.2	2.3	2.4
Uniax	14.4	16.3	2.3	3.4	4.9	5.1
Biax	13.0	17.2	3.5	4.4	3.1	4.5

EXAMPLE 36

Laminate tape backings with polystyrene were made in accordance with the procedures outlined in the above examples. The skins comprised polypropylene (Exxon^{TM} 3014) with a Kraton^{TM} 1107 based core for a three layer construction. Sample A had no polystyrene in the core, while samples B, C and D had 20%, 35% and 50% polystyrene (Dow Chemical Co. 685W), respectively. All had core/skin ratios of approximately 7:1. The tape laminates were laminated with a 1 mil acrylic adhesive (RD-975 - available from 3M Co.). The samples were tested for 0° peel from glass using the procedures outlined above. However, the rolldown was once with a 5 lb(2.27 kg) roller, and testing was performed on an IMASS^{TM} 3M90 Peel Tester. The peel was tested with the as cast tape laminate, and then with readhesion of the same tape a

second and third time. Each measurement is an av rage of
three test runs. The readher d runs 2 and 3, as shown in
Table XXII, have significantly lower peel values
particularly at low polystyrene content. This indicates
the degree of stretch activation initiated in the prior 0°
peel test.

Table XXII

Sample Number	Thickness mils(mm)	0° Peel(1) N/25mm	0° Peel(2) N/25mm	0° Peel(3) N/25mm
A	3.5(0.089)	13.0	6.6	6.16
B	4.1(0.104)	16.0	7.71	7.95
C	4.1(0.104)	21.4	21.0	15.5
D	4.3(0.109)	26.7	26.4	22.3

The percent stretch, here the percent increase
in length over that of the original sample, and percent
recovery, of the stretched length, for each peel are set
forth in Table XXIII.

Table XXIII

Sample Number	First Peel Stretch	Recovery	Second Peel Stretch	Recovery	Third Peel Stretch	Recovery
A	645%	89.5%	645%	89.5%	645%	89.5%
B	485%	89.7%	485%	89.7%	485%	89.7%
C	330%	79.5%	430%	72%	430%	72.0%
D	250%	58.0%	270%	59.3%	270%	59.3%

EXAMPLE 37

The tape of Example 33, sample E, was stretched
to its ultimate draw ratio. The tape was allowed to
immediately recover. The tape was then cut on edge and is
shown in Fig. 17.

EXAMPLE 38

A tape with a Kraton[TM] 1107 core and
polypropylene skins (PP3085) was laminated with an
acrylate adhesive 3M 9458, available from 3M Corporation,
St. Paul, MN. The original adhesive was 1 mil(25.4 μ)
thick. The tape was stretched to its ultimate draw ratio
with the results shown in Fig. 16.

EXAMPLE 39

A sample having the layer composition of Example
27 (with 1% blue pigment in the core) was formed with an
overall caliper of 3.0 mil(0.076 mm) and a core/skin ratio
of 5.1:1. The film was cast onto a chrome casting wheel
with a rubber nip. The 60° gloss was measured using ASTM D
2457-70 using a Gardner Instruments(Bethesda, MD) 60° gloss
tester. The results are summarized in Table XXIV below for
the as cast and three microtextured films (with different
stretch rates).

Table XXIV

| | | 60° Gloss | |
		MD	CD
As Cast	Chrome Side	86	88
	Rubber Side	3.4	3.3
300%	Chrome Side	2.1	3.5
	Rubber Side	1.5	1.9
400%	Chrome Side	2.0	6.6
	Rubber Side	1.6	2.4
500%	Chrome Side	2.2	3.0
	Rubber Side	1.6	1.8

EXAMPLE 40

Laminates from Example 32 were tested for layer
adhesion using a variation of 180° peel test
ASTM D 3330-87. Laminate (0.75 in, 1.9 cm) was placed
between two pieces of masking tape (3M-2503, available from
3M Co., St. Paul, MN) of the same width. Tabs of one tape
piece were adhered to the peel tester platen with
additional pieces of masking tape. The three layers were
pressed together with four passes of a 5 pound(2.3 Kg)
roller and allowed to sit for 10 minutes. The leading edge
of the upper piece of masking tape was attached to the jaws
of a peel tester leaving 0.5 in(1.27 cm) of masking tape to
masking tape contact at the leading edge. The peel tester
was run at 90 in(228.6 cm)/min. The results are set out in
Table XXV below.

Table XXV

Ex	180° Peel (N/25 mm)	Delamination
5	10.2	No
6	14.8	No
7	12.1	Yes
12A	15.3	Yes
12B	14.1	Yes
32A	19.7	No

The various modifications and alterations of this
invention will be apparent to those skilled in the art
without departing from the scope and spirit of this
invention, and this invention should not be restricted to
that set forth herein for illustrative purposes.

We claim:

1. A roll of elastomeric laminate tape characterized in that it comprises a laminate comprised of at least one elastomeric core layer capable of elastic elongation, and at least one outer skin layer which is capable of forming a microtextured surface, wherein when said laminate is stretched past the elastic deformation limit of at least one skin layer the laminate will form a microtextured surface on that layer upon recovery, and at least one substantially continuous adhesive layer on at least one face of said laminate.

2. An elastomeric laminate tape comprising an elastomeric laminate comprised of at least one elastomeric layer and at least one outer skin layer wherein the skin layer has a microtextured surface formed by inelastic deformation of the skin layer in more than one direction and at least one substantially continuous adhesive layer on at least one face of said laminate.

3. A method for forming a roll of microtextured elastic tape characterized in that it comprises the steps of stretching a multilayer laminate backing, comprised of at least one elastomeric layer and at least two skin layers, one of which is a relatively inelastic layer capable of forming a microtextured surface, past the point of permanent deformation of the relatively nonelastic skin layer over substantially the entire laminate cross section such that substantially all of the laminate is rendered elastic for subsequent use, recoving the laminate to form a microtextured skin layer and applying a substantially continous adhesive layer to said laminate backing.

4. An adhesive sheet laminate characterized in that it compris s an elastomeric laminate tap comprised of a laminate with at least one elastomeric core layer and at least one outer microtextured skin layer wherein the sheet has enclosed or partially enclosed spaces for

5 entrapping dust or oil and an opposing outer adhesive layer.

5. A garment having an elasticized region characterized in that it comprises an elastomeric laminate

10 tape comprising a laminate, comprised of an elastomeric core layer and at least one microtextured skin layer, and at least one continuous adhesive layer on at least one face of said laminate.

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6. The elastomeric laminate tape of any of claims 1 to 5 characterized in that the microtextured surface formed comprises folds.

7. The elastomeric laminate tape of claims 1

20 or 3 characterized in that the laminate will recover from its stretched length by 15% or more after 1 second.

8. The elastomeric laminate tape of claims 1 or 3 charcterized in that the laminate will recover from

25 its stretched length 15% after at least 5 seconds.

9. The elastomeric laminate tape of any of claims 1 to 5 characterized in that the coefficient of friction of a laminate with microtextured outer skin layer

30 is 0.5 or less than that of a corresponding non-textured laminate.

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10. The elastomeric laminate tape of claims 1
or 3 characterized in that the laminate will recover from
its stretched length by less than 15% after 20 seconds and
when then exposed to an activation temperature above
26.7°C will recover by at least 50% of the total recovery.

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11. The elastomeric laminate tape of any of
claims 1 to 5 characterized in that the core and skin
layers are bonded together by a tie layer.

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12. The elastomeric laminate tape of any of
claims 1 to 5 characterized in that the laminate width
decreases by less than 20% when restretched to the point
of permanent deformation of at least one previously
deformed skin layer.

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13. The elastomeric laminate tape of any of
claims 1 to 5 characterized in that the surface area of
the microtextured skin layer is at least 50% greater than
an untextured surface.

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14. The elastomeric laminate tape of any of
claims 1 to 5 characterized in that said adhesive layer is
adjacent to at least one outer skin layer of said
laminate.

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15. The elastomeric laminate tape of any of
claims 1 to 5 further characterized by at least two skin
layers, capable of forming a microtextured surface, as
outer layers.

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16. The elastomeric laminate tape of any of
claims 1 to 5 further characterized in that the adhesive
layer thickness is less than 30 microns.

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17.   The elastomeric laminate tape of any of claims 1 to 5 further characterized in that the elastomeric core comprises a non-h at-shrink elastomer.

18.   The elastomeric laminate tape of any of claims 1 to 5 further characterized in that the elastomeric core comprises an A-B-A block copolymer.

19.   The elastomeric laminate tape of claim 18 characterized in that the A-B-A block copolymer comprises a styrene- isoprene-styrene, styrene-butadiene-styrene or styrene-ethylene butylene-styrene block copolymer.

20.   The elastomeric laminate tape of any of claims 1 to 5 characterized in that the stretched laminate recovers by 15% after at least 20 seconds.

21.   The elastomeric laminate tape of claim 2 characterized in that the deformation of the skin layer is created by simultaneous biaxial stretching.

22.   The method of claim 3 characterized in that the laminate is recovered at an activation temperature above 26.7°C further characterized by cooling the stretched laminate to below the activation temperature prior to recovery.

23.   The method of claim 3 characterized in that the adhesive layer is applied to the laminate prior to stretching.

24.   The method of claim 3 characterized in that adhesive layer is applied to the laminate after stretching.

25.   The method of claim 3 characterized in that the adhesive layer is applied prior to recovery.

26.   The sheet laminate of claim 4 comprising a dust mat.

27.   The elastomeric laminate tape of any of claims 1 to 5 characterized in that the laminate is capable of recovering instantaneously, over time or upon the application of heat, depending on the degree of stretch past the deformation limit of at least one skin layer.

28.   The elastomeric laminate tape of any of claims 1 to 3 comprising a tamper-indicating tape.

29.   The elastomeric laminate tape of claim 1 characterized in that the tape delaminates or tears when stretched.

30.   The elastomeric laminate tape of any of claims 1 to 3 comprising a removable label having a non-adhesive coated outer skin layer.

31.   The garment of claim 5 characterized in that at least one microtextured skin layer is not adhesive coated to provide a low friction surface for engagement with a wearer.

32.   The garment of claim 5 characterized in that it comprises a diaper and said elastomeric tape is used to engage the wearer.

33.   The elastomeric laminate tape of any of claims 1 to 5 characterized in that the laminate is a film formed of substantially coextensive layers having relatively constant average thicknesses across the width of the laminate.

34. The elastomeric laminate tape of any of
claims 1 to 5 characterized in that the core and skin
layers remain in substantially continuous contact
following stretching and recovery.

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35. The elastomeric laminate tape of any of
claims 1 to 5 characterized in that the skin and core
layers remain in substantially intermittent contact
following stretching and activation.

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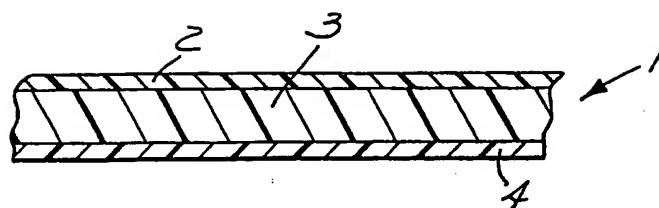
Fig.1

Fig.4

Fig. 2

Fig. 5

100 0U
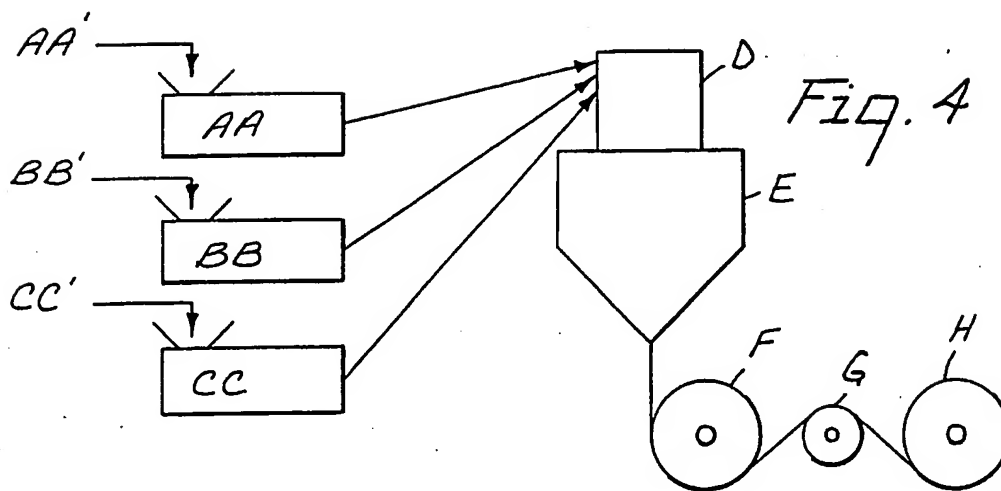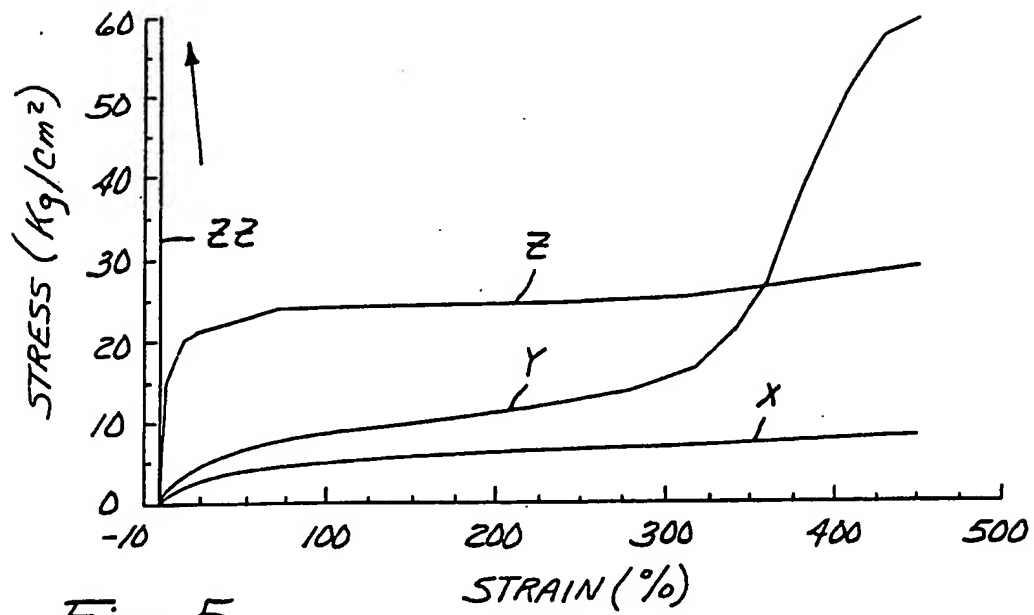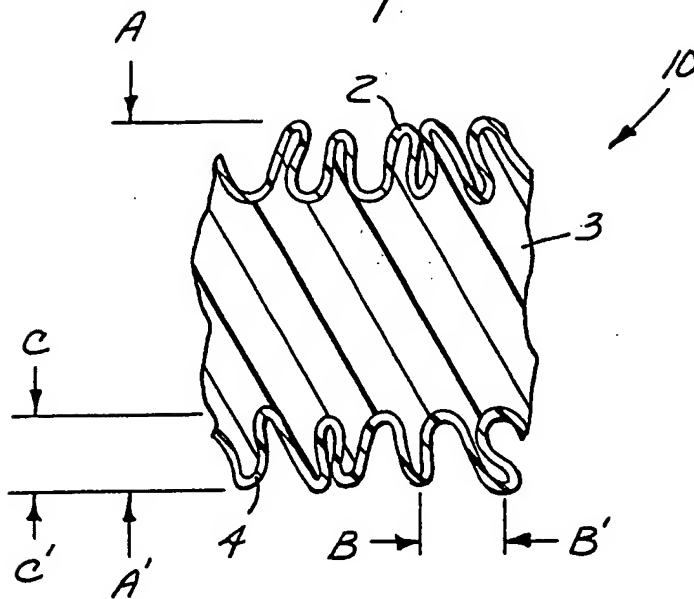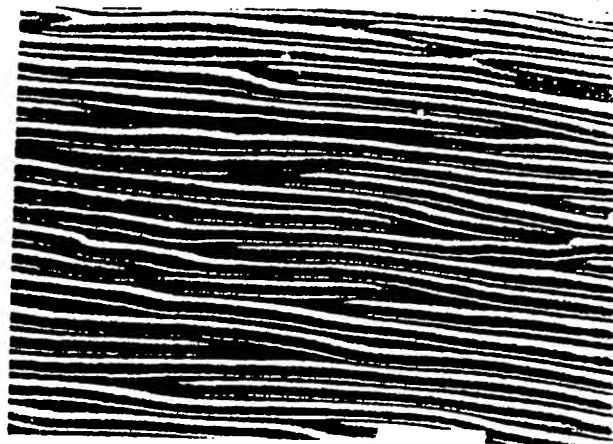
Fig. 3

Fig. 6

Fig. 10
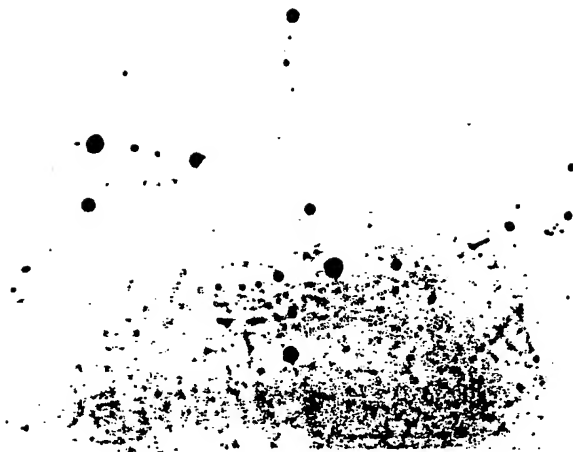
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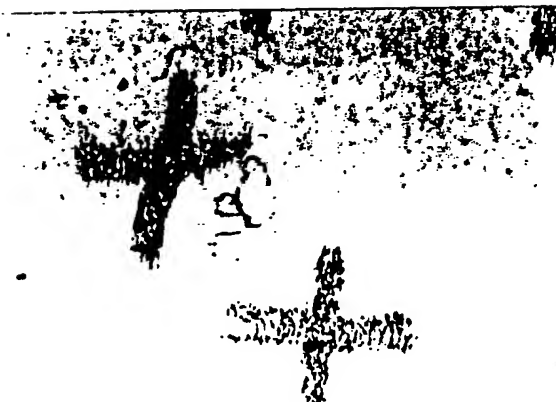
Fig. 8

Fig. 14

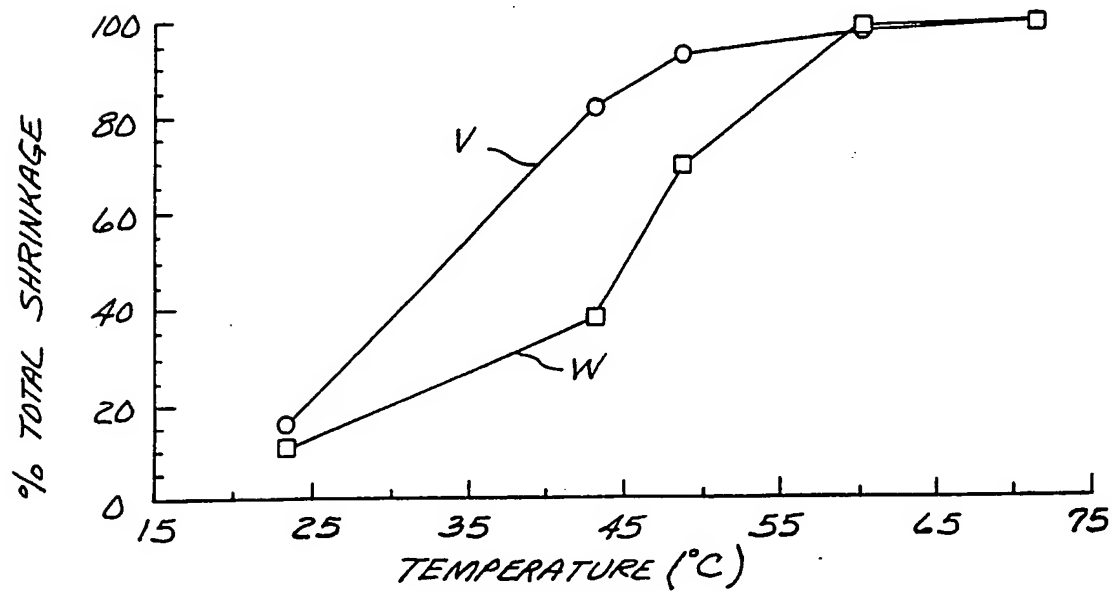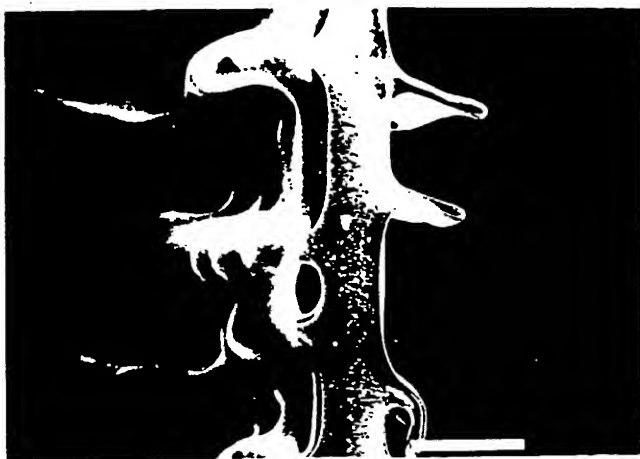Fig. 15

Fig. 9

Fig.11

Fig. 12

Fig. 13

←———— /00 OU
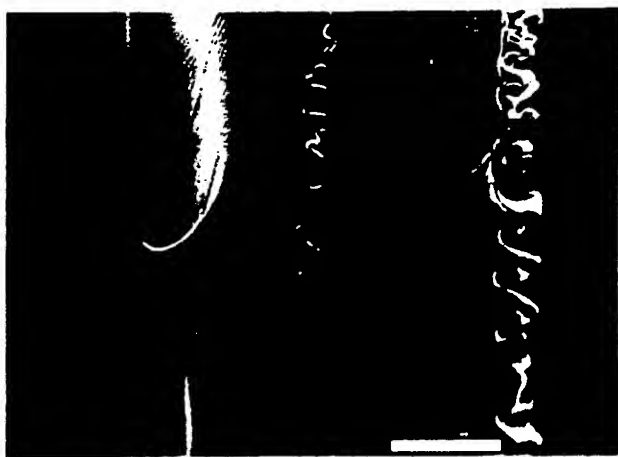
Fig.16

←———— /00 OU
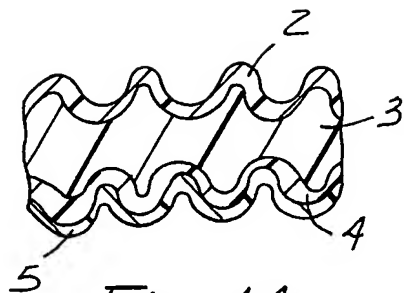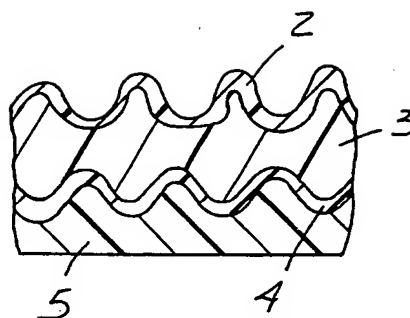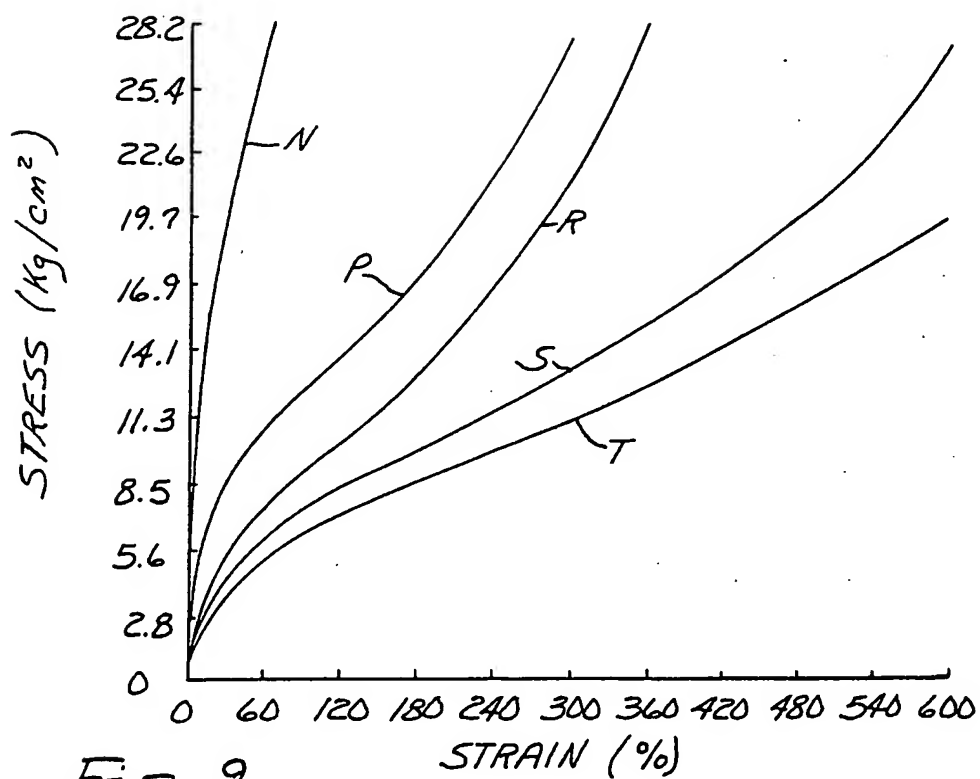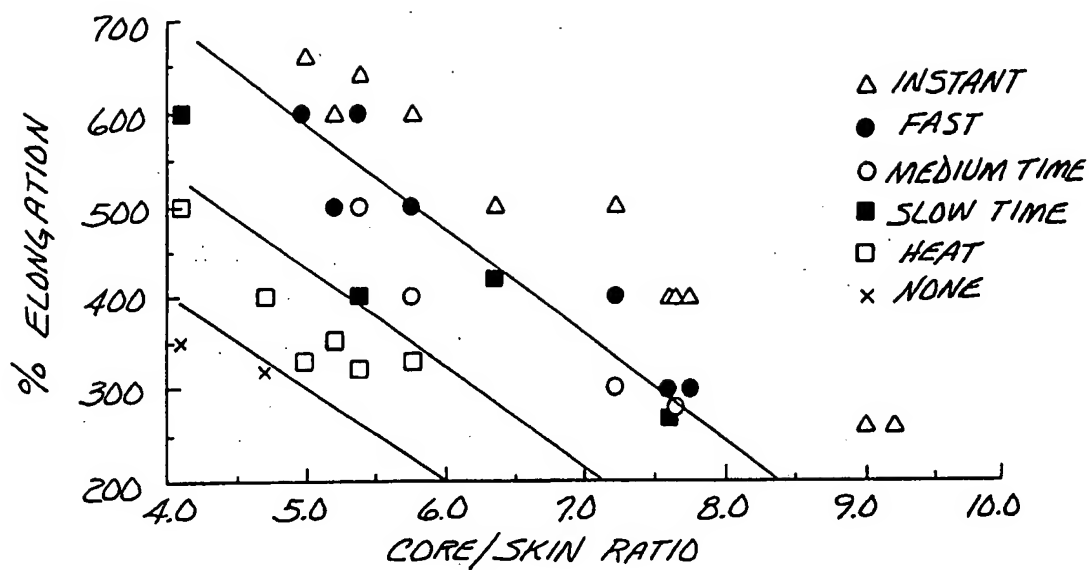
Fig.17

INTERNATIONAL SEARCH REPORT

International Application No   PCT/US 91/00609

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5   B32B25/08 ;   B32B5/04 ;   B29C55/02 ;   A61F13/58

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	B32B ; B29C ; A61F ; C09J

Documentation Searched other than Minimum Documentation
to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category[o]	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
A	US,A,4880682 (HAZELTON ET AL.) 14 November 1989 see column 1, line 57 - column 2, line 28 see column 6, lines 24 - 52; figures 1-3 ---	1-35
A	US,A,4834741 (SABEE) 30 May 1989 see column 2, line 38 - column 3, line 49 see column 3, line 40 - column 4, line 2 see column 4, lines 22 - 53 see column 7, lines 37 - 61 see column 9, lines 26 - 41 see column 9, lines 26 - 41 see column 9, lines 60 - 68; figures 1-3, 7, 8 ---	1-35
A	EP,A,102245 (CHICOPEE) 07 March 1984 see page 5, line 3 - page 7, line 9 ---	1-35
A	US,A,4023571 (COMERFORD ET AL.) 17 May 1977 see claims 1, 8 see column 5, lines 33 - 40 ---	1-3, 5

-/--

° Special categories of cited documents :[10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
27 JUNE 1991	01. 02. 5.

International Searching Authority	Signature of Authorized Officer
EUROPEAN PATENT OFFICE	IBARROLA TORRES O.

Form PCT/ISA/210 (second sheet) (January 1985)

Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	US,A,4237889 (GOBRAN) 09 December 1980 see claim 1 see column 3, line 38 - column 4, line 36 ---	1

III. DOCUMENTS CONSIDERED TO BE RELEVANT   (CONTINUED FROM THE SECOND SHEET)

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.   27/06/91

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US-A-4237889	09-12-80	None		